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IN MEMORIAM

THOMAS BURKITT COLLIER

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THOMAS BURKITT COLLIER

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Thomas Burkitt Collier, for twenty-one years the Treasurer of The Cincinnati Society of Natural History, was born at Athens, Ohio, September 16, 1848, and died at Cincinnati, May 20, 1915. His father, Daniel Collier, removed from Athens to Cincinnati shortly before the Civil War, and for a generation was prominent in steamboat and insurance circles, and was the second Mayor of Avondale, a village since annexed to Cincinnati. The son was educated in the public schools of Cincinnati, a brief period spent in a local military academy, and at Ohio Wesleyan College at Delaware, Ohio, but did not graduate. After leaving school, he engaged in mercantile pursuits in Cincinnati. During a large part of his business life, he was the head of the firm of Collier, Budd & Co., coal dealers, operating an elevator in Cincinnati, and handling with their fleet of steamboats and barges the output of mines along the upper Kanawha River.

In 1879, he was married to Miss Mary Ella Shaddinger, of Cincinnati, who, with two sons, Lester Dupont Collier and Ashton Collier, survives him.

As early as 1884, he took up photography as a pastime, and for the remainder of his life was a most enthusiastic devotee of the art. He supplied himself at his home with a complete equipment of apparatus and materials and turned off a great deal of work that would have been a credit to any professional studio in the land. He was lavishly generous as a photographer toward the schools, public and private, giving them every commencement season much of his time and skill gratuitously. He became expert in photographing interiors and large outdoor groups. Naturally he found his way early into the Cincinnati Camera Club, the organization of the amateur photographers of the

city, and at once became prominent in its activities. After the Camera Club ceased to exist as a separate organization, and its members united with The Cincinnati Society of Natural History, Mr. Collier for two years served as the Curator of the Photographic Section.

He was elected a member of the Society on January 5, 1886, and in 1890, became a life member. In 1891, he was chosen a member of the Executive Board at large. In 1892, he was elected President, and re-elected in 1893. In 1894, he was elected Treasurer, and was annually re-elected thereafter up to and including the year 1915. In 1908, the Executive Board employed him as Director of the Museum and Clerk of the Board, a position he continued to hold until his death. The records of the Society fail to disclose any individual service which has been so varied or of such long duration. For almost one-half of the life of the Society he served it as Treasurer. Two years as Curator of Photography, one year as member of the Executive Board at large, two years as President, twenty-one years as Treasurer and seven years as Director of the Museum and Clerk of the Board, constitute a record for faithfulness and efficiency which it will be hard ever to equal. Business cares never so engrossed him that he did not have time to lend his presence and counsel to the affairs of the Society. Except when kept away by impaired health, he was never absent from the meetings of the Society or the Executive Board. Promptness to the minute in keeping an appointment was the watchword with him and the rule that he always observed in this regard he exacted of others. After he became the Director of the Museum, which position carried with it that of Custodian of the Society's building, he took great pride in improving as far as possible the physical condition of the Society's property. His own private affairs did not receive more attentive consideration at his hands than did the business of the Society entrusted to his care.

He was a born enthusiast—a striking characteristic of his make-up being the zeal and interest he manifested in

anything which he undertook. In the later years of his life, he became interested in astronomy, and found much intellectual recreation in the study of this subject. His enthusiasm reached out to his friends for he loved them devotedly. If he had an enemy, which is doubtful, he hated him cordially. Rare conversational powers made of him a charming companion and delightful entertainer.

He believed in doing things, was constantly at it, and his friends, this Society included, the beneficiaries of his tireless efforts in their behalf, will look in vain for some one to take his place.

NATURAL HISTORY NOTES OF SOUTHERN ARIZONA

By Charles Dury.

Arizona—That anomalous country, with a fauna and flora so peculiar, and different from other sections of North America; with faunal areas so very unlike each other, even though separated by short vertical distances; where the torrid dry desert of the lowlands is replaced at higher altitudes by a climate most delightful, and with peculiar and beautiful vegetation. A study of the desert flora impresses one with the adaptability of many of these plants to unfavorable conditions, resulting from long periods of heat and dryness. This fierce struggle for existence producing some remarkable modifications of growth. The Giant Cactus, *Cereus giganteus*, the Barrel Cactus, *Echinocactus Wislizeni*, and that amazing Ocatilla *Fouquiera splendens*, always hold me spellbound by their grotesque oddity. Under the influence of the July rains, the Ocatilla puts forth its second yearly crop of soft, green leaves that mask its array of long and needlelike thorns. Here insect life depends on rainfall as much as does plant life. When the rainy season begins in midsummer, the insect fauna appears like magic. Each species seemingly endowed with resistless energy and rapidity of action in the perpetuation of the species. The entomologist who visits this country in the height of the dry season will surely be disappointed. I arrived in Tucson, Arizona, July 7, 1915. The weather was very dry and hot. On the evening of that day I visited the electric street lights in search of insects with no results whatever. There was nothing out. On the afternoon of the 8th, at about 4 p. m., a heavy shower of rain occurred, that lasted over an hour. That evening at 9 p. m., insects were flying around the arc lamps in the streets in swarms. Beetles, bugs and orthoptera whirled around in clouds. The streets beneath the lights were covered with insects and thousands were crushed by vehicles. Large pale crickets were feeding on the bodies on their mangled fellows. The beetles most in evidence

were *Cotalpa*, *Polyphylla* and *Stractegus*, with a host of smaller species. Automobiles passing under these lights received a shower of insects. In corners and recesses of buildings heaps of insects were piled up. I remained here until July 12th, and every night this deluge of insects continued. On July 12th, I went to the Santa Rita Mountains, a most interesting locality for a naturalist. Some of the canyons on the western side of this range are well watered and covered with fine trees and curious plants. During my stay here a large collection of insects of all orders was made. Of the Coleoptera, or beetles, many interesting species were secured. The plants most prolific in producing beetles were the different forms of cactus. The cactus faunae has been well described by the late Henry G. Hubbard in Psyche and the Proc. Ent. Soc. of Washington, D. C. The large weevil, *Cactophagus validus*, was common, clinging to the Prickly Pear (*Opuntia*). The Tree Cactus *Opuntia versicolor*, is attacked by a Longicorn, *Coenopoeus palmeri*, that causes an exudation of gum, which hardens and forms lumpy black masses on the stem of the plant. The colors of the beetle mimic this blackish exudation and makes them difficult to see. They cling so tightly to the plant that they must be pried off. The needlelike thorns of these plants furnish them good protection. In some huge Barrel Cactus which I found in the proper condition of decay there were swarms of beetles of many species, that feed on the moist, fermenting pulp. The large *Hololepta yucateca* and the smaller *Cacti* and *Vicina* were abundant. A perfectly huge histerid, *Omalodes grossus*, was rare. The very active *Xanthopyga Cacti*, *Belonuchus Masocharas* and other interesting *Staphylinidae* went rushing about seeking safety in crevices and holes in their efforts to escape. At the base of the plants in the wetter pulp, were quantities of large dipterous larvae. The cacti are the only plants that have much moisture in them, and the moist decaying interior is very attractive to insects. One may travel for miles over sunburned plains and foothills without finding a drop of moisture anywhere.

Approaching one of these Barrel Cactus or "Bisnagas," in a half-decayed condition, one can not see any insect life from the outside, but cut or break it open and the interior will be swarming with insects, mostly beetles, of many species. This is the cactus that is used by travellers from which to obtain water, when caught in these deserts without any. The flavor of the sap is not very pleasant, but is sufficient to supply enough moisture to sustain life in an emergency. Under suitable stones or other cover were clusters of *Discoderus* that were greenish when fresh, but in drying this color faded out in most of the specimens. Color has been made use of as a specific character in this genus in some descriptions, but it is of no value. Specimens of *Neobrotica pleuristicta* were beaten from a bush that bore green pods, containing red beans which are said to be fatal to horses if they eat them. I was unable to learn the name of this plant. The Honey Pod Mesquite *Prosopis velutina*, and Cat's Claw, *Acacia greggi*, when beaten into an umbrella, yielded many species, *Tyndaris* and other *Buprestidae* with Longicorns and Chrysomelidae. July 15.

I noticed a mesquite tree almost defoliated by *Epicauta pardalis*. A few strokes on the limbs brought down a pint of these beetles into the umbrella. Only certain trees seem to be attacked by them. They go in swarms and, after eating up one tree, move to another. At light, at night many good species were taken. *Pseudomorpha* ran over my paper with lightninglike speed. *Listrochelus* and *Phytalus* occurred, though not abundantly, but *Lachnosterna*, *Diplotaxis* and *Anomala* were. Two species of *Aneflus* were common, as was *Mallodon*, and other smaller longicorns. On the flower heads of *Daslerion wheeleri* swarms of *Lycostomus loripes* congregated, and the active, bright-colored *Clerus spinolae* was frequent. On the side of one of these flower heads, I took a large Mantis, purple and green in color. It had three purple blotches on each wing cover. It was chewing a bumblebee, and was the only one I saw of the species. The tribe of grasshoppers were abundant.

The large species called Toad Grasshopper (*Phyrnotetix Magna*) were common. July 14, many pairs taken in couple. They varied much in color, and closely resembled the color of the ground where they lived. Some specimens taken among fragments of disintegrated, rust-colored rock were colored just like the rock, so much so that it was impossible to see them unless they moved. The female is huge in size, the males much smaller. They can not fly, having the wings aborted. This mimicry of color is doubtless a protection from the keen eyes of numerous mocking birds who feed largely on grasshoppers. During July, many of the *Locustidae* and *Acrididae* are mature, though some species are not until later. A few species were of very bright colors, one kind found higher up in the canyons had beautiful blue hind wings. A huge, long-winged grasshopper was powerful in flight and difficult to catch. It is called *Schistocera vaga*. Some of the round holes in the ground were occupied by giant Tarantulas. One monster we dug out at a depth of ten inches made a savage bite at the net handle, but, after that gave up and died quickly in the cyanide jar. The deadly foe of these huge spiders is a wasp called Tarantula Hawk, belonging to the genus *Pepsis*. Some specimens taken were two inches long, with a wing spread of three and one-half inches. Their sting is most formidable, and desperate battles take place between them and these huge spiders, and the wasp generally wins, though not always. The object the wasp has in attacking the spider is to deposit her egg on the body of the paralyzed spider, which serves as food for her young. The spider evidently knows that one thrust of the sting will be fatal, and makes a desperate effort to escape. The peculiar paralyzing and preserving effect of the virus of the wasp's sting is one of nature's marvels, for if the sting killed the spider outright, its body would decompose before the young wasp larva reached maturity. Pouring water into the Tarantula's hole generally brings them to the surface. In turning over logs, some monster centipedes were uncovered. They are very striking

looking fellows, of a rich orange-olive color, with heads and the three posterior segments dark green. When disturbed, they bite savagely. They sometimes come into one's tent and crawl under the blankets and are very disagreeable bedfellows. The ants of Arizona, like those of Texas and New Mexico, are a conspicuous feature of the insect fauna. The different species and modifications are legion. The Agricultural Ant (*Pogonomyrmex*) clears away all vegetation, sometimes for a space thirty feet in diameter around the entrance to its nest. Some very interesting beetles live in the nests of these ants. But, as the ant stings severely, one must not let them touch the skin, for the instant they do, they sting. One that got up my trouser's leg stung me four times in as many seconds. He who digs for Myrmecophilus coleoptera in their nests will have his troubles. In the early Spring and late Fall, the ants are not nearly so aggressive. Mr. McCleary, a ranchman, kills them when they come near his house by placing lumps of fused cyanide at the entrance to their nests, this he moistens with water from time to time. Every ant that touches this cyanide is killed, and they can not go in or out without touching it. He has tried pouring liquid cyanide and bi-sulph. carbon into the nests with only partial success. I saw heaps of dead ants he had killed at the nests he had treated, and not a living ant was to be seen. Some beetles had also been killed by touching this deadly cyanide. This ant is a pest of such great importance in some situations that they must be gotten rid of at any cost. Its sting is most peculiar and painful, and is most quickly relieved by using ammonia on the affected parts. The aggregate area of grass lands denuded and destroyed by these ants in Arizona, New Mexico and Texas must be very great. Another curious ant is a black species of *Pheodole* that lives under stones. Some of them have enormously developed heads and nutcrackerlike jaws. They are said to be the seed crackers of the colony. This species does not sting and is harmless and inoffensive.

A very interesting insect is the Arizona Carpenter Bee, *Xylocopa arizonica*, and its nest is wonderful. I found a Daslerion plant that was dead and had the large, dry flower stalk standing. It was nine feet high. On one side of the stem were some circular holes. Striking the stem a sharp blow caused a buzzing inside that was terrifying. I chopped the stem off and split it open, and thirty mature Carpenter Bees dropped out and went tumbling over the ground. The manner of making this nest was a marvel of skill in selecting the best location and material available for the purpose, and is not excelled by any other bee. The pithy interior of the stem is cleanly excavated and the debris cemented together, used to make the septem between the cells, and in each cell one of these beautiful, shining, blue-black bees was hatched and matured.

Some beautiful Lepidoptera were flying in July. The majestic *Papilio daunus* sailed through the trees and over the tops of the mesquite bushes, once in a while visiting a flower, stopping only for an instant, then taking flight again. The freshly hatched ones were very difficult to catch. Those that had flown for several days being less wary. A number of pretty skippers were darting through the open glades in the woods, the most conspicuous of which was *Achalurus cellus*, which had the habit of darting at every other insect that came near. At moist places in the creek bed, clouds of brilliant blue Lycaenas rose up on being disturbed, fluttering over the spot where they had congregated, only to alight again, when the danger was past. Very few moths came to light. From the great number of larvae seen, July 12 to 24, the imagos must come later. *Anosia berinice*, *Chlorippe leilia*, *Terias mexicana*, with numbers of skippers, satyrids and lycaenids, were all flying in favorable places, though the freshly hatched ones not easy to catch. Some showy and remarkable Hemiptera were taken. One huge species attracted my attention by its bright red and white color in its immature stages. It was several days before the mature form appeared. July 20, while beating mesquite bushes, I

saw a cluster of these bugs in the top of a bush. On knocking them into the umbrella, I found three adults of this large and beautiful species. There were twenty of the larval forms in the cluster. The males have enormously developed posterior legs. *Cicada* were very scarce, only one species was taken. Its note is weak and seldom heard.

The bird fauna of the Santa Ritas is one of the most interesting of North America. At the earliest daybreak their music began, a veritable medley of melody. In the wild, rocky canyons, birds are rather scarce, but around this ranch house, situated as it was, in a dense grove of live oaks and surrounded by thickets of thorny bushes, with an abundance of water, made it an ideal resort for birds. Vermin, such as wild cats, lynx, hawks and other enemies of bird life, were welcomed with a charge of shot by the ranchman.

The white-winged dove was so noisy its cooing was deafening. July 14, I noticed that birds of several species were very much excited and in great commotion in the trees overhead, screaming and chattering at some object high up in a live oak tree under which I sat. A female white-winged dove fluttered to the ground almost at our feet, as though in great distress, quivering her wings and acting as though wounded. She seemed to be trying to entice some enemy away from her nest, telling us as plainly as though she could speak, that her babies were in peril. Scanning the branches of the tree from which she came, I expected to see an owl, but finally discovered a large snake stretched along a limb. A load of shot brought it writhing and twisting to the ground. Noticing a lump in its body, I cut it open and found it had swallowed a young Arizona Hooded Oriole. This snake was five feet long and was called by the ranchman, a bullsnake. When the body of the snake was disposed of, the birds resumed their normal occupations. They were very tame and came close to the cabin door. apparently realizing that they were protected. The ranchman enjoys their company and does not allow them to be

molested. I identified the Band-tailed Pigeon, White-winged Dove, Carolina Dove, Arizona Plumed Quail, Hooded Oriole, Arizona Cardinal (whose flaming livery of scarlet outshone the form we have in Ohio), Texas Cardinal, Mocking Bird, Red-shafted Flicker, Arizona Jay, Canyon Towhee, Crissel Thrasher, Painted Red Start, Crimson Flycatcher, Mountain Mocking Bird, Rufous-backed Humming Bird, and a much larger species that I identified as *Eugenes fulgens*—only one seen. At evening, some croaking Ravens came into the live oaks to roost, and after dark, while I was at work catching insects, I heard the curious cry of some Pygmy Owls overhead, although none were seen.

The Herpetologist can find some interesting reptiles in these mountains. The Gila Monster, *Heloderma suspectum*, lives on the mesa and foothills, and is not often seen. July 25, we caught one near the ranch house. It was out on an open sandy spot. On being approached, it opened its mouth and repeatedly darted out its tongue, hissing loudly. There is a legend that its breath is noxious and deadly, but I brought my face close to it, without any ill effect, so concluded this to be a myth. The ranchman told me to kill it, as it was a great robber of ground-nesting birds, eating their eggs. Several hard blows on the head, that would have killed any ordinary animal, only stunned it. Though I supposed it was dead when I left it, expecting to get it later, I found it had revived and made off. The tenacity of life is very great in these reptiles. I am just in receipt of a letter from the ranchman, describing a fight between one of these Helodermas and a rattlesnake, the two having been put in a pit from which they could not escape. "The snake struck the monster fairly, drawing blood. Then the monster got hold of the snake and hung on until the snake was dead. The monster was not harmed." McCleary asks is it known that the Gila Monster is immune to the poison of Rattlesnakes? Aside from Heloderma's habit of feeding on the eggs of ground-nesting birds, I can see no reason for destroying them, as they are certainly the most curious and

interesting reptile in North America. The Arizona snakes are many of them of very pretty species. I saw a number of the smaller non-venomous species, but I did not disturb them. July 24, while taking a walk of eight miles, from one canyon to another, I was caught in a cloudburst. The rain came down in sheets. I opened my collecting umbrella and crouched under a leaning tree, but soon found my pockets were full of water, though I managed to keep my insect specimens fairly dry. When near camp on the way back, I came across some snakes that had evidently been drowned out and seemed to be travelling for higher ground. One large rattlesnake crossing the trail tempted me to drop a a huge rock on its head. These reptiles seemed to be as uncomfortable as I was. The creek beds, usually dry, were raging torrents and large rocks and boulders went rolling and grinding down, propelled by the resistless current. I saw a specimen of a curious little rattlesnake, very small, though adult, killed by a miner. I had previously killed another in Grant County, New Mexico, July 4, 1915.

When I had my light out in the evenings collecting beetles, a small toad came out of a hole in the cabin wall, hopped over to my paper and took up a position near my light. At intervals it would snap up a beetle. When it swallowed a *Cyclocephala* or *Listrochelus*, it was very amusing to watch its expression and see it roll its eyes, turn and twist, and scratch at its sides with its feet, as the victim in its stomach endeavored to get out. One evening I kept count and it devoured eighteen beetles, none smaller than *Diplotaxis*. By midnight it was filled up and retired to its hole between the rocks in the cabin wall. Each evening, when this toad emerged from its hole, it would be flat and thin, but when it retired, it was swelled to aldermanic proportions, so much so that it was with difficulty it could squeeze into its hole. Finally it failed to reappear and I saw it no more. Either the abnormally abundant diet brought by my light was too much for it, or some snake made a meal of it.

The high mountain of southern Arizona, Old Baldy, 9432 feet high, is an easy mountain to ascend, and the view from the top will well repay the effort. The U. S. Department of Forestry has cut a trail to the top, making the ascent both safe and easy. July 23, I found the Ladybug, *Hippodamia convergens*, up there by millions. The ground was covered in places, and they were piled up under the low, stunted shrubbery in heaps. I filled my hat with them in a few scoops of my hands. Many pairs were in couple, and all seemed to be in lively, healthy condition. Down lower on the mountain side none were seen. I could not discover the meaning of this strange migration, unless it was a sort of honeymoon trip that insects, as well as the genus homo, take to some expensive and uncomfortable place. When impregnated, do these beetles descend the mountain to deposit their eggs among the plant lice, which form the food for their young?

TWO NEW BEETLES FROM CINCINNATI, OHIO

By Charles Dury.

Family Trichopterygidae (Ptiliidae)

Genus *Nanosella*—*N. atrocephala*, **n. sp.**

Body elongate, narrow, sub-parallel, testaceous in color, except the head which is shining black when fresh, convex and prominent. Front swollen and projecting. Antennae 11-jointed, with 3-jointed club. Eyes large and coarsely faceted. Prothorax as long as wide, base arcuate, sides broadly feebly rounded. Base wider than apex. Angles not prominent, surface sparsely punctured and with sparse, stiff, recumbent hairs. A transverse groove or impression at base. Scutellum visible and triangular. Elytra at base as wide as prothorax, sub-parallel, tips separately rounded, and nearly three times as long as prothorax. Punctures sparse and hairs as in prothorax. Beneath, prosternum long before coxae. Front coxae large, transverse and contiguous. Middle coxae separated by the produced point of prosteronum. Posterior coxae widely separated and broadly laminate. Under surface finely punctuate and clothed with prostate pale hairs. Eleven specimens taken near Cincinnati, Ohio, July 13, 1914, on the fungus *Poria cinerea* Sch. found growing on the under side of an elm log. Length .50mm. A longer species than *Nanosella fungi*, but much narrower. A remarkable little insect. Cotype in National Museum.

Family Calandridae

Genus Phloeophagus—*Phloeophagus variolatus*, **n. sp.**

Body elongate, sub-cylindrical. Color piceous, shining. Legs and antennae pale. The beak short, thick, continuous with the front. Scrobes short, directed below the eye. A feeble transverse gular groove. Head beneath transversely wrinkled. Antennae stout with 7-jointed funicle. Club oval. Antennae inserted at middle of beak. Eyes very

flat and finely faceted. Head rather finely punctured. Prothorax longer than wide. Sides slightly arcuate. Punctures variolate larger than those of head. Anterior coxae very narrowly separated. Elytra about twice as long as prothorax, and slightly wider at humeri, with coarse quadrate punctures. Interspaces as wide as striae, each with a row of minute punctures sparsely placed. Scutellum small. Body beneath with sparse coarse variolate punctures. Middle coxae more widely separated than anterior ones. Posterior widely separated. Ventral segments five, 1st, 2d and 5th long, 3d and 4th very short. Length 3mm. Thirty-four specimens examined, all taken walking on the trunks of standing dead beech trees in company of *Phloeophagus* minor and *Wallastonia* and *Stenoscelis*, Cincinnati, Ohio, May to July.

A NORTHERN OCCURRENCE OF DENTARIA MULTIFIDA MUHL.

By E. Lucy Braun

In the spring of 1913, the writer found a large patch of *Dentaria multifida* Muhl. (*Dentaria laciniata* var. *multifida* James) growing in a mixed beech woods near Madisonville, a suburb of Cincinnati. This habitat has since been destroyed, but plants from the original habitat are growing in the Emery Bird Reserve, and in the writer's garden.

This plant is not recorded, to my knowledge, as occurring north of the northern boundary of Virginia and Tennessee, and hence is not included in any of the texts dealing with the floras of north-eastern North America. The plants were compared, for verification of identification, with plants in the Lloyd Herbarium, collected on Lookout Mountain, Tenn., by Joseph F. James. The only difference noted is that of size, the more northern plants being only about two-thirds the height of those from Chattanooga

Although James states (Bot. Gaz. 8:206, 1883 and Jour. Cin. Soc. Nat. Hist. 7:67, 1884) that on Lookout Mountain he found forms intermediate between *D. laciniata* and *D. multifida*, the plants found at Cincinnati were very distinct, and no gradational forms were found.

In this latitude, the plants bloom from the middle to the end of April—two to three weeks later than *D. laciniata*—and the seeds ripen about the first of June. This is a very beautiful plant, much more delicate and attractive than the other species of Dentaria growing here.

Dentaria multifida Muhl. (4-5)

THE CINCINNATIAN SERIES AND ITS BRACHIOPODS IN THE VICINITY OF CINCINNATI

By E. Lucy Braun

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PART II

PART I

I. Introduction

The region about Cincinnati is underlain by a series of alternating shales and limestones. This series, to which the name Cincinnatian has been given, is of Upper Ordovician age. The city of Cincinnati lies to the north of the center of a low dome. To the east, north, and west of it, are younger rocks; to the south of it, are older rocks. The quarries about Cincinnati, the steep valley-sides of the Ohio River, and especially the beds of the smaller valleys

present numerous exposures of all but the lowest beds of the series. Fossils are exceedingly abundant at many horizons, and they are as a rule very well preserved. The soils of this region are to a large extent derived from the decay of the bed-rocks, the limestones yielding a much more fertile soil than the shales. Glacial and loess deposits cover a considerable portion of the area, modifying the character of the soil and often concealing the bed-rock.

The present paper is a study of the rocks of the Cincinnatian series in the vicinity of Cincinnati, and of the brachiopods of this series—a class of fossils more abundant and better represented than any other, except the bryozoans. The discussion of the rocks is based on the literature of the Cincinnatian series and on field observations made by the writer through a period of several years. In the work on the brachiopods, the literature and all available specimens in the Museum of the University of Cincinnati were studied. The bibliography of each species is as nearly complete as possible. In the treatment of the different species, the original description (if available) is given except where some later one was considered better. This is followed by a discussion of the distinctive characters and notes on the occurrence and abundance at Cincinnati.

The paper was prepared in 1911 and 1912 in partial fulfillment of the degree of Master of Arts in the Department of Geology of the University of Cincinnati. It is a pleasure to acknowledge to Professor J. Ernest Carman my appreciation of his many helpful suggestions during the progress of the work.

II. Stratigraphy

A. Lithology of the Cincinnatian Series

The rocks of the Cincinnatian series are made up of thin beds of shale and limestone. The shale beds vary in thickness from a few inches to several feet; the limestone strata from a fraction of an inch to eight or twelve inches. The

proportions vary in different formations, but the general lithological characters are quite uniform throughout the series. The shales are blue and calcareous, thin-bedded, and poorly consolidated. In place, they are firm and compact, but soon crumble on exposure to weathering. Although in general, the shale contains a rather poor fauna, specimens of some of our rarer fossils which are seldom found in limestone strata, have been found beautifully preserved in the shale.

The Cincinnatian series is divided on lithological and faunal grounds into five formations, each of which is again subdivided, as shown in the following table. The classification used here follows Bassler for the Eden, Fairview, and McMillan formations, and Cumings for the Richmond.

Cincinnatian	Richmond[*]	Elkhorn	
		Whitewater	
		Saluda	
		Liberty	
		Waynesville	
		Arnheim	Oregonia
			Sunset
	McMillan[†]	Mt. Auburn	
		Corryville	
		Bellevue	
	Fairview[†]	Fairmount	
		Mt. Hope	
	Eden[†]	McMicken	
		Southgate	
		Economy	
	Utica	Fulton[‡]	

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*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 621.

†Bassler: U. S. Nat. Mus., Bull. 92, 1915, vol. 2, pl. 2.

‡For the use of this term see Bassler: Proc. U. S. Nat. Mus. xxx, No. 1442, 1906, pp. 8, 9; Foerste: Science, N. S., vol. 22, 1905, pp. 150, 151; Ulrich: Bull. G. S. A., vol. 22, 1911, pp. 296, 297.

1. *Utica.*—The name Eden was proposed by Orton in 1873* for a succession of alternating shale and limestone layers comprising about 250 feet of strata at the base of the Cincinnatian series. In 1897, Winchell and Ulrich† replaced this term by Utica, believing this formation to be the equivalent of the New York Utica. The five feet of strata at the base of the Eden, as defined by Otron, contain *Triarthrus becki*, which is characteristic of the New York Utica. The major part of what Winchell and Ulrich called Utica does not contain fossils characteristic of the true Utica, and is no longer correlated with the Utica, but is now known as Eden. The lower five feet of strata are referred by Bassler‡ to the Utica formation, and given the name Fulton, from the type locality—Fulton, in the East End of Cincinnati. He describes the rocks of the Fulton as "dark gray or drab-colored shales which contrast very distinctly with the overlying Eden shales."§ This formation, which outcrops at 45 to 50 feet above low water of the Ohio at Cincinnati (432 ft. A. T.), is the oldest formation of the Cincinnatian. It is underlain by Trenton,‖ the oldest rock outcropping in the Cincinnati region.

2. *Eden.*—The Eden at Cincinnati is approximately 230 feet thick, and is made up of a series of thin-bedded, calcareous shales, interrupted at intervals of several feet by limestone strata varying in thickness from a fraction of an inch to six or eight inches. The formation is characterized by certain fossils which are restricted to it, or which occur abundantly in it. Among these are *Climacograptus typicalis*, *Heterocrinus heterodactylus*, *Callopora onealli sigillarioides*, *Dalmanella multisecta*, and *Plectambonites sericeus*. Besides

*Orton: Geol. Surv. Ohio, vol. I, pt. I, 1873, p. 372.

†Winchell and Ulrich: Geol. Nat. Hist. Surv. Minn., vol. 3, pt. 2, 1897.

‡Bassler: Proc. U. S. Nat. Mus., vol. 30, No. 1442, 1906, p. 9.

§Bassler: loc. cit., p. 8.

‖The strata outcropping along the Ohio River bank at West Covington, Ft. Thomas, and Pt. Pleasant, which have been usually correlated with the Trenton of New York, have been shown by J. M. Nickles (Ky. Geol. Surv., bull. 5, 1905, p. 18) to be continuous with the Winchester of central Kentucky. He considers them to be of Cincinnatian, rather than Mohawkian age. Bassler (U. S. Nat. Mus. Bull. 92, 1915, pl. 2) however, refers them to the Mohawkian.

these fossils, which may be considered as characteristic of the Eden as a whole, there are certain other fossils, which are characteristic of one or more of its members.

The members of the Eden are: lower or Economy (50 ft.), middle or Southgate (120 ft.), and upper or McMicken (60 ft.). These members are characterized by certain Bryozoa:* the Economy by *Aspidopora newberryi*; the Southgate by *Batostoma jamesi*; the McMicken by *Dekayella ulrichi*. Lithological distinctions between these divisions are not clearly marked. The Eden is a formation of much greater uniformity than any of the succeeding formations.

Besides the typical bryozoan of each member, other fossils which are easily recognized, but not as uniformly present, may be mentioned. In the Economy may be found: *Dalmanella emacerata, Leptaena rhomboidalis gibbosa, Pholidops cincinnatiensis, Plectambonites plicatellus*, and *Trinucleus concentricus*. The Southgate contains a more meager fauna than the Economy and is not sharply differentiated from the beds above or below it. *Dalmanella emacerata, Pholidops cincinnatiensis*, and *Trinucleus concentricus* are here also, and *Rafinesquina squamula*, which does not occur again below the Fairmount (see table, Part II), is occasionally present. The McMicken contains a rich bryozoan fauna, and but few representatives of the other classes.

Exposures of the Eden around Cincinnati are not common. On Elberon Ave. and on Straight St. are good exposures of the higher beds; the lower strata are exposed only in a few stream beds near the river level.

About 210 to 220 feet above the base of the Eden is a prominent horizon marked by two massive limestone strata separated by about eight or ten feet of shale. The lower limestone stratum is 5 to 8 inches thick, and contains few

*Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 69.

fossils. The upper is 8 to 16 inches thick, and its upper surface is usually well covered with *Dalmanella multisecta.* A few inches of the shale just beneath the upper stratum is often almost entirely composed of the shells of this brachiopod. In places, the upper three feet or more of the shale bed is largely limestone, in which case this becomes a prominent limestone horizon. The most marked spring horizon of the region is just beneath the lower limestone stratum. Above this stratum, the rocks are porous, allowing the downward passage of ground-water; below, they are quite impervious, necessitating a lateral movement of ground-water. This results in seepage at many places along the outcrop of the upper shale layers, which often is sufficiently concentrated to form permanent springs. The upper limestone stratum, which is the highest horizon containing *Dalmanella multisecta*, is regarded as the top of the Eden.

3. *Fairview and McMillan* (*Maysville*).—Until recently, the rocks of the Fairview and McMillan formations were grouped in one formation, the Maysville, which was subdivided into five members. In both the Fairview and McMillan, alternation of shale and limestone is the most prominent characteristic, more prominent even than in the Eden. The limestone totals about thirty per cent of the thickness; and strata six inches thick are common. The shale of the Fairview and McMillan is often of a lighter blue color than that of the Eden, and much of it is of a coarser texture, and less compact; the limestone, although always impure, is more compact and crystalline here than at any horizon of the Eden.

Fossils are much more abundant in these formations than in the Eden. The surfaces of many of the layers of crystalline limestone are almost completely covered with fossils. Throughout these formations, brachiopods and bryozoans are by far the more numerous fossils, while all the other phyla of invertebrates with the possible exception of the Protozoa, are represented. A number of species are per-

sistent throughout both the Fairview and McMillan; among them are *Lepidodiscus cincinnatiensis*, *Hebertella sinuata*, and *Platystrophia laticosta*. Certain genera are characteristic of the two formations as a whole. Platystrophia, which is rare in the Eden,* is very abundant and characteristic; Plectorthis is, with the exception of a single species, *P. plicatella*, restricted at Cincinnati to these formations; and Zygospira and Refinesquina, although found quite frequently in the Eden and Richmond, are most abundant in the Fairview and McMillan. Cyclonema, Lophospira and Byssonchia are also common.

The Fairview is divided into two, and the McMillan into three members, based mainly on faunal content. The members differ considerably in lithological character.

Mt. Hope.—The Mt. Hope, named from its typical exposure on Mt. Hope Road near the foot of Price Hill, where the entire member is beautifully exposed, contains about seventy-five per cent of shale. It resembles the Eden, but the proportion of limestone is considerably greater. As exposed on Straight St., west of the University, the Mt. Hope has a thickness of about 50 feet. The type fossil is *Amplexopora septosa*.† A single stratum containing *Strophomena planoconvexa* marks the contact between the Mt. Hope and the next higher member, the Fairmount.‡ On most exposures, the contact is difficult to locate, as this fossil is not always present.

Fairmount.—In the Fairmount limestone forms about thirty-five per cent of the total thickness. About half of this is suitable for building stone, and it is the limestone of this division which is most commonly quarried in the vicinity of Cincinnati. The Fairmount is the highest division exposed on many of the lower hills about Cincinnati, as at Fairmount, Hyde Park, and Avondale. It is also the

*Nickles states, Ky. Geol. Surv. Bull. 5, 1905, p. 32: "No Platystrophia has been noted in the Eden," but a few have been found in the Eden at Cincinnati.

†Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 76.

‡Nickles: loc. cit., p. 77.

highest bed-rock on the hills back of Newport and Covington. On Straight St. where a good section is exposed, this division is about 60 feet thick. While fossils are less abundant in this member than either above or below, the number of species represented is far greater, and the specimens are better preserved. The bryozoan *Dekayia aspera*,* is the type fossil of this member, while *Glyptocrinus decadactylus*, *Callopora dallei*, *Constellaria constellata*, *Platystrophia crassa*, *Modiolopsis modiolaris*, *Cyclonema mediale*, and *Lophospira ampla* are characteristic.

Bellevue.—The lowest member of the McMillan formation is the Bellevue, a division lithologically and faunally different from the underlying and overlying strata. It has a thickness of only 20 feet. The lower 15 feet is composed almost wholly of limestone which is made up largely of a frondlike bryozoan, *Monticulipora molesta*. This horizon is more resistant than the upper part of the Fairmount on which it rests, so that it stands out prominently on the faces of many of the bluffs around Cincinnati. The upper 5 feet of the Bellevue is composed of thin-bedded shales and shaly limestones. These shaly limestone beds are made up almost entirely of single valves of *Rafinesquina alternata fracta*, with clay partings between the shells. On weathering, the clay partings break down leaving a jumbled mass of poorly preserved shells. This horizon, known as the "fracta zone," is one of the most easily recognized horizons of the entire Maysville. It is less resistant than the lower part of the Bellevue and usually forms a steep slope at the top of the projecting cliff. The type fossil of the Bellevue, *Monticulipora molesta*, is present, although not as abundant as in the lower fifteen feet. *Platystrophia laticosta* is common throughout the "fracta zone," and *Hebertella sinuata*, *Rafinesquina alternata*, and a number of molluscs are abundant in the lower part of this horizon.

Corryville.—The Corryville member of the McMillan, which is 60 feet thick, includes a series of thin limestones

*Nickles: loc. cit., p. 77.

and yellowish shales. Of itself, it is not a distinctive horizon. It is only because of its marked contrast with underlying and overlying members of the McMillan formation, that the Corryville is easily recognized. In the field, it is usually identified by means of its position with relation to other members, or by means of the characteristic bryozoan of the member, *Chiloporella nicholsoni.** The Corryville beds are exposed on the higher hills around Cincinnati. Fossils are abundant: *Platystrophia lynx* is quite large; pelecypods, *Anomalodonta* and *Byssonchia*, are plentiful; and the bryozoan, *Callopora ramosa*, is very abundant and well preserved.

Mt. Auburn.—The Mt. Auburn is composed of a nodular calcareous shale or shaly limestone, 20 feet thick. The type fossil of this member is the large gerontic form of *Platystrophia lynx*. This is especially abundant throughout the lower 5 to 12 feet, and may be found throughout the entire member. Other fossils are not abundant. This member is represented at Cincinnati only by its basal part, which is the highest bed-rock on several of the highest hilltops, as at Fairview Heights (Clifton Ave. and McMillan St.), Price Hill, and Westwood. The Mt. Auburn is the highest division of the McMillan, since it is now known that the overlying Arnheim (Warren), which was formerly placed in the Maysville should, because of its faunal relations, be classed as basal Richmond.

4. *Richmond.*†—With the exception of the lower strata of the Arnheim, the Richmond formation is not found nearer than about thirty miles to the east, north, and west of Cincinnati. To the south, it is even farther removed, because the center of the Cincinnati anticline is to the south of Cincinnati, in Jessamine Co., Ky. At certain horizons, the Richmond formation resembles the Eden more

*Nickles: Jour Cin. Soc. Nat. Hist., vol. 20, 1902, p. 83.

†The discussion of the Richmond formation is taken largely from Cumings' paper, "The Stratigraphy and Paleontology of the Cincinnati Series in Indiana," Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907; and Nickles, "Richmond Group in Ohio and Indiana," Amer. Geol. xxxii, 1903, pp. 202-214.

than it does the Fairview or McMillan, for it is in general a shale formation. In one division, the Liberty, the limestone is however more massive and more evenly bedded than the limestone of the Fairview and McMillan formations at Cincinnati. Faunally the Richmond is more closely related to the Eden, representing a return to conditions existing during the Eden stage. The presence of corals in this formation is a distinctive feature. Columnaria, Tetradium, Streptelasma and Protarea, are common. The Richmond formation is divided into six members.

Arnheim.—The Arnheim is 80 feet thick and has been divided by Foerste into a lower unfossiliferous division, the Sunset, and an upper richly fossiliferous division, the Oregonia.* The basal part is exposed in a cut on the C. & O. Ry. about one mile south-west of Cheviot. This is the nearest exposure to Cincinnati. *Homotrypa bassleri* is given by Nickles, (loc. cit.) as the type fossil of the division.

Dinorthis retrorsa, which has a very restricted vertical range occurs 35 feet below the top. *Leptaena rhomboidalis*, (Richmond form), *Rhynchotrema dentata*, *Streptelasma*, and *Columnaria*, indicate the advent of a Richmond fauna, and unite this division more closely with the overlying than with the underlying strata.

Waynesville.—Lithologically the Waynesville, (the lower Richmond of Nickles), is largely clay or clay shale of an intense blue color, with a few thin limestone layers, 2 to 5 inches thick. It is characterized by the presence of *Dalmanella meeki* in great abundance throughout the zone. *Calymene callicephala* is abundant, and *Leptaena rhomboidalis*, which is present near the top of the division, extends upward into the Liberty.

Liberty.—The Liberty is composed largely of limestone beds, which sometimes reach a thickness of 8 to 12 inches but average about three inches. The limestone, although

*Foerste: Ohio Naturalist, vol. 12, No. 1, Jan. 1912.

forming the predominating rock of the division, is interbedded with thin layers of shale. The base of the Liberty is marked by the first appearance of *Hebertella insculpta*. *Strophonema planumbona*,* from which the Liberty is called the Strophonema zone, *Rhynchotrema capax*, *Plectambonites sericeus*, *Bythopora meeki* and *Rhombotrypa quadrata* are present in large numbers. The upper layers contain fewer fossils, and in places become argillaceous and arenaceous.

Saluda.—The Saluda division is even more markedly argillaceous or arenaceous than the upper layers of the Liberty. The typical exposure of this division is at Madison, Indiana, where it is chiefly a sandy limestone, or calcareous sandstone. Northward, it becomes more calcareous, and coarse sediments are lacking. At Richmond, Indiana, it is represented by only a few feet of massive limestone. On the east side of the Cincinnati anticline, the Saluda is chiefly a shale horizon. In the southern area of its outcrop in Indiana, ripple marks and sun cracks are common in the more shaly layers. Reef building corals, *Tetradium minus* and *Columnaria alveolata*, are very abundant. Two coral reefs are present, separated from each other by several feet of argillaceous rock. In the southern portion of the area both are composed of Columnaria. If these are traced northward, the upper is seen to be replaced by Tetradium. The Tetradium reef is much more persistent than the Columnaria reef, but is absent at Richmond, Ind. Both corals become much less abundant in the northern part of the area. At Madison, Ind., the Saluda is separated from the Silurian by 20 feet of mottled limestone, which represents only the lower portion of the Whitewater. Cumings† interprets the Saluda as a shore deposit related to the Whitewater and Elkhorn, which overlie the thin calcareous representative of the Saluda in the more northern sections, as at Liberty and Richmond, Indiana. Many authors consider the White-

*S. planumbona (Hall). See Nickles: Am. Geol. xxxii, 1903, pp. 214-217.
†Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 673.

water to be the immediate successor of the Liberty, not having recognized the thin, more northern representative of the Saluda. The Saluda contains a very poor fauna, except towards the top, where certain brachiopods and bryozoans which are common in the Whitewater, begin to appear.

Whitewater.—The Whitewater is composed of nodular and concretionary shales and impure limestones, often of a brownish or yellowish color. It contains a much richer fauna than the Saluda. The predominate fossils are bryozoans, which are very abundant. *Rhynchotrema capax* which is common in the lower part of the member is replaced by *Rhynchotrema dentatum* near the top. *Platystrophia acutilirata* and *Hebertella occidentalis* are characteristic fossils.

Elkhorn.—The upper 50 feet of the Richmond contain a fauna very different from that of the preceding Whitewater, and are designated by Cumings as the Elkhorn division of the Richmond.* The lower 15 feet of this member is shale, containing few fossils. The fauna of the Elkhorn is made up of recurring Fairview and McMillan types. *Hebertella sinuata*, *Platystrophia laticosta*, and other species with their closest relatives in the Maysville. The division is characterized by a form of *Platystrophia lynx* known as *P. lynx moritura*.

B. Structural Features of the Cincinnatian

The structural features of the Cincinnatian are of two kinds: original features, those which show conditions existing during the epoch; and secondary features, those which indicate subsequent events.

1. *Original.*—Under the first class of structural features may be considered wave-marks or "giant-ripples," mud-balls, sun-cracks or mud-cracks, and worm borings.

*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 678.

Wave-marks.—Many limestone layers of the Eden and Fairview formations have undulating upper surfaces and plane lower surfaces. Such undulations are wave-marks or the so-called "giant-ripples." The crests and troughs of the wave-marks are in general approximately parallel. The distance from crest to crest varies from two to four feet. The thicknesses of the wave-marked strata vary from one to three inches in the trough, to three to six inches at the crest. The material of which these wave-marked limestones are composed is, as far as has been observed, always fragmental. The wave-marked strata are usually overlain by shale, which is sometimes laminated, but more often homogeneous. Where laminated, the laminae usually conform to the wave surface of the limestone stratum, the waves gradually dying out before the next bedding plane is reached.

The direction of the wave-marks is not uniform. In some cases waves have been observed to trend at almost right angles to those of other strata but a few inches above or below. Of fifteen wave-marked strata observed, ten have the crests and troughs extending in directions included in the northeast-southwest quarter of the compass, and five have the crests and troughs extending in a general northwest-southeast direction. That is, in general there seems to be a division into two groups, (1) those with NE-SW trend, and (2) those with NW-SE trend. One slope of the wave-marks is steeper than the other. Five examples of the first group (NE-SW) were observed for position of steeper slope, and one of the second group (NW-SE). In the first group the steeper side was toward the southeast; in the second, to the northeast. This indicates that the waves moved in a southeasterly direction when forming those wave-marks having a NE-SW trend, and in a northeasterly direction when forming those with NW-SE trend. The southeasterly movement appears to have been the more general.

The following table records observed data for sixteen wave-marked strata.

Altitude of stratum	Horizon	Direction of wave-marks	Distance, crest to crest	Height of crest above trough	Steeper side
450′	Trenton	....	4′	4-6″	....
530′	Eden	N70°W-S70°E	3′	4″	....
530′	Eden	N-S	2′ 6″	2″	....
530′	Eden	N70°W-S70°E	2′	1″	....
540′	Eden	NW-SE	2′	2″	....
565′	Eden	N-S	2′ 8″	3″	....
565′	Eden	NW-SE	2′ 6″	2-2.5″	....
661′	Eden	N27°E-S27°W	2-3′	3″	SE
665′	Eden	N80°E-S80°W	4′	1.5″	S
....	Fairview	N55°E-S55°W	3′	1.5″	SE
....	Fairview	N80°E-S80°W	....	....	....
715′	Fairview	N12°E-S12°W	1½-2′	....	....
730′	Fairview	N45°E-S45°W	2-3′	2.5″	SE
731′	Fairview	N50°W-S50°E	2′ 3″-2′ 6″	....	NE
760′	Fairview	N45°E-S45°W	2′ 9″	2.5″	SE
760′	Fairview	N20°E-S20°W	1′ 8″	....	....

These waved-strata indicate that the water was not too deep for the sediments to be moved by the more powerful waves, and the fragmental nature of the material of the strata shows that it had been much worked over before it was finally left with a waved surface, to be covered with a deposit of mud and thus preserved. None of these wave-marked strata have as yet been shown to be continuous over any considerable area, but they have been observed in all parts of the area, and at various horizons in the Eden and Fairview formations. They may have been formed either in shallow water near a shore line, or in shoal water which was independent of a shore line. Many of the wave-marks trend approximately in the same direction (NE-SW), indicating the possible existence of a land mass not far distant. There are, however, a few prominent exceptions to these in strata but a few inches above or below, whose directions could not have been controlled by the same shore line. It therefore seems more probable to the writer that they were formed in shoal water, and that their direction was controlled by the wind.

Mud-balls.—In some limestone layers there are rounded masses of shaly material, varying in size from one to three inches in diameter. The material is very different from that of the containing stratum, being best shown when in limestone made up of comminuted shells. Upon weathering these masses are in some cases released from the containing limestone and may be found free on the surface. These masses are interpreted as fossil mud-balls. They were probably formed from irregular masses of mud broken off by waves from mud layers nearby or just beneath the newly forming sediments. After being worn and rounded by the waves the mud-balls were dropped and became imbedded in the finer sediment being deposited.

Sun-cracks.—Sun-cracks are not known to exist in the Eden or Maysville formations, but are quite prominent in some of the shale layers of the Saluda member of the Richmond. They indicate extremely shallow water conditions, with short emergences, allowing the mud to dry partially and crack, before being covered with another layer of sediment.

Worm borings.—Many of the more shaly strata are curiously marked with what are thought to be worm borings. These worm borings are of two types:—(1) those extending along the bedding planes, and (2) those passing into and through the beds. The first type probably represents the path of worms crawling along the sea-bottom; the second, of worms burrowing into the mud.

2. *Secondary.*—Under this class of structural features are those indicating subsequent events. They include the Cincinnati anticline, local folds and faults, and joint cracks.

The Cincinnati anticline.—The strata of the Cincinnatian series at Cincinnati appear to be horizontal. They are, however, part of a low broad anticline extending from Nashville, Tenn., northward through Kentucky, to Cincinnati. Near Cincinnati the anticline divides into two branches, the one extending northwestward toward Chicago, the other northward through western Ohio. This anticline

is divisible into two domes—the Nashville dome of Tennessee and the Jessamine dome,* culminating in Jessamine Co., Ky. The whole uplift is known as the Cincinnati anticline.

Local folds and faults.—The rocks of the Eden and probably of the Maysville are locally distorted by low anticlines, which are only a few feet across. Thrust faults are in many cases associated with these folds, the fault plane running in the direction of the axis of the anticline. No faults are known to exist in this region except in connection with anticlines. These faults have a throw of several inches and a hade of 25° to 35°. There appears to be no accordance of direction of the axes of these folds and faults.

Thirteen small folds and faults have been noted by the writer within the area of the Cincinnati quadrangle. Of these eight are at an altitude of from 620 to 640 feet A. T.† or from 30 to 50 feet below the Eden-Fairview contact, that is, are found in the McMicken member of the Eden. Five of the observed folds affect the shale bed and limestone strata just beneath the Eden-Fairview contact.

In all the folds and faults of the lower series (those of the McMicken), but a small section is exposed, so that it is not known to what extent the distortion affects the strata vertically. All are in stream beds, and while cross sections of the folds or combined folds and faults are usually exposed in stream banks, it appears that the axes trend in the same general direction as the stream valleys in which the folds are found. One faulted anticline which was observed‡ is exposed in the undercut bank of a meander curve. The fault where exposed in the stream bank has a hade of 30° and throw of six inches. Upstream, the fault dies out in a low almost symmetrical anticline, whose sides have a dip of almost 10°. The fold extends only about 25 feet in the same direction before disappearing entirely. Its extent in the other direction is not shown.

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*Matson: U. S. Geol. Surv. Water Supply Paper 233, 1909, p. 26.

†These altitudes are judged from the topographic map of the Cincinnati quadrangle.

‡On the west branch of Sycamore creek, north central part of section 22, Symmes township.

The folding of strata just below the Eden-Fairview contact is usually of a very irregular nature, thus differing from the folding at the lower horizon, which is much more regular. At this higher horizon the axes are parallel to the stream valleys. Only two or three feet vertically are affected the distortion seldom extending upward to the Dalmanella layer.

Two possible explanations of these folds and faults in the Eden shales present themselves: (1) lateral compression due to dynamic action during the formation of the Cincinnati anticline; (2) buckling due to removal of load in stream valleys in recent times.* The observed folds seem to be separable into two groups—or possibly three groups if those reported from the Maysville be considered—differing in regularity of folding and extent of distortion. The first group includes those folds of the Eden shale (McMicken) found at horizons 30 to 50 feet below the Eden-Fairview contact. The axes of these folds are apparently somewhat parallel to the stream valleys (or to the general trend of the valleys), and are without accordance of direction. These folds are usually quite regular and sometimes almost symmetrical. The second group includes those folds found at the top of the Eden, with their axes parallel to the stream valleys. These are always very irregular, and the strata seem to be crushed and broken rather than distinctly and regularly folded.

Considering first the folds and faults of the lower series (McMicken), uniformity of horizon would favor the first explanation, as it would seem probable that these folds at a common horizon, should have a common origin. Lack of accordance of direction of axes is opposed to it, as lateral compression, working over the area through which these folds are distributed, would produce a general parallelism of axes. Their existence in stream valleys would suggest the second explanation, affecting possibly an inherently

*For a known example of buckling due to a similar cause, see Bull. Geol. Soc. Amer. vol., 20, p. 625.

weak horizon, a fold occurring whenever this horizon is properly situated topographically. Their direction, more or less parallel to stream valleys is favorable to the hypothesis that they have resulted from buckling due to removal of load in the valley.

The second group, at the top of the Eden, seems to be adequately explained by the hypothesis of buckling. Here, the axes are parallel to the stream valleys. In all cases where folding exists at this horizon, the stream bed is suddenly cut deeper just beneath the Eden-Fairview contact. This horizon lies just beneath a formation which contains a rather large proportion of limestone and is therefore stronger than the shale beneath. When this support is removed buckling may occur, as the shales cannot withstand the downward force on either side.

Joint cracks.—In the Cincinnati region the rocks are affected by two very persistent systems of vertical joints, having general east-west and north-south directions. These joints are not uniformly spaced, varying usually from about one to three feet apart. Both systems extend far beyond the Cincinnati region, as indicated by the following statement from Matson: "In the Blue Grass region there are two well-developed systems of vertical joints at approximately right angles to each other. These joints have general north-south and east-west directions and are apparently very persistent."* It is probable that these two systems of joints are coextensive with the Cincinnati anticline. They affect both shales and limestones, but are more prominent in the limestones. These joints are taken advantage of in quarrying the limestone strata, the joints forming easy fracture planes often doing away with the necessity of blasting. Weathering first takes place along these joint planes, manifesting itself in the yellow oxidized borders of the joint blocks. The joint cracks greatly facilitate the circulation of ground-water, and become much enlarged by solution in the purer limestone strata.

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*Matson: U. S. Geol. Surv. Water Supply Paper 233, 1909, p. 28.

A number of limestone sinks are known in the Cincinnati quadrangle in places immediately underlain by the Bellevue, which contains some of the purest limestone strata of the series. They probably owe their existence to the falling in of the roofs of caverns which were formed by the solution of the Bellevue limestone.

III. Geologic and Physiographic History

A. Paleozoic Era

1. *Cincinnatian epoch.*—During the Cincinnatian epoch the interior of the continent was a vast epicontinental sea, with land to the east, north, and west. Toward the close of the Mohawkian epoch the sea became shallow enough to affect the character of the sediments. The Winchester and Lexington limestones (Mohawkian) of central Kentucky and the Bromley and Pt. Pleasant (Trenton) of northern Kentucky and southwestern Ohio, which contain upward an increasing amount of shale, give evidences of the shallowing of the epicontinental sea in the Cincinnati region. The wave-marked limestone layers composed of fragmental material and the mud-balls of the Pt. Pleasant indicate that the sea had become quite shallow. A slight disconformity exists at the top of the Pt. Pleasant, pointing to a short emergence of this area at that time.

Eden stage.—Throughout the Eden stage the sea remained quite shallow and a large part of the material deposited was mud. The mud-balls and wave-marked limestone layers of this formation previously described also indicate shallow water deposition. The amount of material deposited (230 feet) was far greater than that of the two subsequent stages, and almost equal to that of the Richmond. The life of the Eden stage was meager for the muddy waters were unfavorable to abundant life. Bryozoans, though not abundant, were fairly well represented, and trilobites (Calymene and Isotelus) and pelecypods (Byssonchia) were not uncommon.

Maysville stage.—During the Maysville stage, the supply of mud was lessened, as is shown by the increased proportion of limestone upward in the formation. It is not known whether this clearing of the seas was due to an actual diminution in the amount of mud supplied, or to a deepening of the sea which would reduce the amount of terrigenous material brought to this place. But we do know that at times the sea was quite shallow, for in the Fairmount member where limestone is relatively more abundant than at any lower horizon in the Cincinnatian, there are several waved limestone strata. As these are composed largely of fragmental material, they could not have been deposited at a depth greater than that at which such material can be agitated by the waves. The Maysville stage was a time favorable to the existence of abundant animal life, and especially to such forms as brachiopods and bryozoans which inhabited clear waters.

Richmond stage.—During the Richmond stage, conditions changed frequently, as is shown by the alternation in the character of the rock. These varying conditions were probably produced by epeirogenic movements. The Arnheim (basal Richmond) was a time of deposition of shaly limestone and of shale. The change from clear water conditions of the McMillan stage to the muddy waters of Arnheim time affected the life of the seas very strongly as is shown by the scarcity of fossils in the lower division of the Arnheim (Sunset). Later in the Arnheim time (Oregonia), life became abundant, but the species and even the genera were largely different from those of the previous stage. The Arnheim time was transitional between the McMillan and the Richmond stages. Muddy water conditions inaugurated during the Arnheim time prevailed during the deposition of the Waynesville, and in accord with this, species closely related to those of the previous muddy water stage, the Eden, appeared, such as *Dalmanella meeki*, *Leptaena rhomboidalis*, and many bryozoans. Following the Waynesville time the seas again cleared, inaugurating

the most pronounced limestone making age of the entire Cincinnatian, the Liberty. This was characterized by an abundance of brachiopods whose nearest relatives lived in former limestone making epochs—Trenton and Maysville. After 35 feet of calcareous material had accumulated, the clear seas were suddenly terminated by a return to muddy waters, and an extensive shoaling of the sea. It is probable that at the time of the formation of the coral reefs of the Saluda and the deposition of its coarse terrigenous sediments, a part of the Cincinnati anticline had emerged, and that the shore features of the Saluda were caused by the presence of this land. Some of the shaly strata of the Saluda bear sun-cracks, showing that a part of the area occupied by these rocks was occasionally even above the surface of the sea. Terrigenous material was still supplied during the deposition of the Whitewater and the Elkhorn, but it was less coarse than that of the Saluda. At Madison, Ind., the highest beds of the Richmond formation are absent and the Clinton rests unconformably upon the lower portion of the Whitewater. This shows that the area of the land did not remain constant, but at times diminished in size permitting the overlap of younger sediments.

As has been indicated, the Richmond stage was a time of epeirogenic movements in the eastern interior of the continent. The sediments of the Medinan series of New York indicate that this epoch was a time of epeirogenic movements in the east. The Richmond is a formation known only in the interior basin; the Medina and Oneida formations of the Medinan of New York are known only in the Appalachian district. Both represent a time of changing depths of seas, and shifting land masses. Because of the peculiarities of their distribution, the movements accompanying their deposition, and the character of their sediments, a question has arisen as to the possible equivalence of the Richmond and basal Medinan formations, and if they are equivalent, to what system, the Ordovician or

Silurian, they belong. Cumings* considers that the movements of the Richmond and Medina stages were related, and that the Richmond is equivalent to a part of the Medina. Bassler† places the Richmond formation in the Silurian system, evidently in accordance with this idea of its contemporaneity with the eastern formations.

2. *Silurian period.*—That an emergence of the Cincinnati anticline occurred late in the Richmond or early in the Silurian is further indicated by the different nature of the later Silurian formations to the east and west of the anticline. The Clinton of Ohio and Indiana is very similar faunally and lithologically‡ thus precluding the existence of any extensive land mass at that time, but the Waldron of Indiana§ and Tennessee is not represented by any similar formation in the area to the east of the anticline, which might be interpreted by assuming that a land barrier existed between these two basins. It is probable that during the subsequent periods of the Paleozoic, this area was generally above the sea, but was low lying and suffered little erosion.

B. Post-Paleozoic Time

At the close of the Paleozoic, all the eastern interior was raised above sea level, and there was extensive deformation in what is now the Appalachian Mountain region. Long continued erosion then followed resulting in the formation of an extensive peneplain in Cretaceous time. Evidence of this peneplain still remains in the mountain regions, but has been obliterated from the great interior areas underlain by less resistant rocks, where it was no doubt also formed. After the formation of the Cretaceous peneplain, there was an uplift which inaugurated a second great period of erosion, again resulting in the formation of a peneplain in Tertiary

*Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 687.

†Bassler: Proc. U. S. Nat. Mus., xxxix, 1911, pp. 509, 517; U. S. Nat. Mus. Bull. 92, 1915, vol. 2, pl. 3.

‡Foerste: Amer. Jour. Sci., vol. 18, 1904, pp. 321-342.

§Kindle and Barnett: Ind. Dept. Geol. Nat. Res., 33rd Ann. Rep., 1908, p. 401.

time. This peneplain which was only partial in the mountain regions, was almost completed over vast areas of the interior of the continent.* At this time the area at Cincinnati was peneplained. This Tertiary peneplain is represented by the level crests of the hills about Cincinnati. Upon this plain, stood a few low-lying monadnocks, which now show a very low swells above the flat-topped uplands. The Tertiary peneplain was uplifted, and then began the development of the present topography of the region. At the beginning of the Pleistocene period, most of the present stream valleys were formed, and the topography was similar to that of today. During the Glacial Epoch the topography was modified by changes in drainage, by the deposition of till, and by outwash deposits. Post-Pleistocene erosion has completed the development of the existing topographic features.

IV. History of the Nomenclature

Early in the nineteenth century, the "Blue Limestone" as the Cincinnatian series was then called, became well known because of its wonderfully abundant fauna. Many attempts have been made to correlate it with the formations of the eastern states, resulting in the application, at different times, of various names. At one time it was considered by James Hall to be the equivalent of the Trenton of New York (including Trenton, Hudson River, and Utica slate), and throughout Volume I of the New York Paleontology, reference is made to the Cincinnatian series as the "Trenton limestone." Nickles, in 1903, in his paper, "The Geology of Cincinnati"† gave a concise and adequate account of the history of the nomenclature up to that time. At that time, the names Utica and Lorraine were accepted terms. Later investigations have shown that the Utica of New York is represented by only the basal five feet of the formation formerly called Utica at Cincinnati. To this five feet the

*Campbell, Richmond Folio (No. 46); Fenneman, U. S. Geol. Surv., bull. 348, p. 43.

†Nickles: Jour. Cin. Soc. Nat. Hist., vol. 20, 1902, p. 52.

term Fulton has been applied[*] and the major part of the formation formerly called Utica is now known by Orton's term Eden.[†] The Fairview and McMillan formations have until recently been included under one formational name. For many years, this series of strata was considered to be the equivalent of the New York Lorraine, and was known by this name. Later, as it became evident that these strata were not the exact equivalent of the Lorraine, the name Maysville[‡] was proposed. This name was used for several years, but is now being superseded by two names, Fairview and McMillan, which Bassler[§] has proposed for the two divisions of the Maysville which he raises to formational rank. These two formations, together with the Eden and Utica, he included in the Covington group. Recently the Richmond has been referred to the lower Silurian.[‖]

The following table is intended to show the scope and equivalents of the various names which have been applied to parts of the Cincinnatian series in the vicinity of Cincinnati.

*Bassler: Proc. U. S. Nat. Mus., xxx, No. 1442, 1906, p. 9.

†Winchell and Ulrich, Geol. Nat. Hist. Surv. Minn., vol. 3, pt. 2, 1897, p. cii.

‡Foerste: Science, N. S. vol. 22, 1905, p. 150; Nickles: Ky. Geol. Surv. Bull. 5, 1905, p. 15; Cumings: Ind. Dept. Geol. Nat. Res., 32nd Ann. Rep., 1907, p. 621.

§Bassler: loc. cit. p. 10.

‖Bassler: Proc. U. S. Nat. Mus. xxxix, 1911, p. 509-517; U. S. Nat. Mus., Bull. 92, 1915, pls. 2, 3, 4.

Early Authors	…oximate ht. …e low water …e Ohio, …T. 432 ft. …sler, 1906	Elevation A. T. of upper contact, Straight St. section
Blue Limestone Trenton Limestone (in part) Hudson River Group Cincinnati Group.	25′-665′	
	5′-700′	
	0′-625′	
	0′-590′	
	0′-540′	
	25′-460′	
	0′-425′	855′
	5′-390′	795′
	25′-375′	775′
	30′-325′	705′-713′
	20′-280′	673′
	00′-220′	
	50′-100′	
	45′- 50′	

Early Authors	Orton, 1873, Ohio Geol. Surv. vol. 1, p. 371	Winchell & Ulrich, 1897 Minn. Geol. Surv. vol. iii, pt. 2, p. lxxxix	Nickles, 1902 Jour. Cin. Soc. Nat. Hist. vol. 20, pp. 64-98		Nickles, 1903 Amer. Geol., vol. 32, p. 218		Foerste, 1905 Science N. S., vol. 22, p. 151		Nickels, 1905 Ky. Geol. Surv. Bull. 5, p. 15		Bassler, 1906 Proc. U. S. Nat. Mus. 30, No. 1442, p. 8			Cumings, 1907 Ind. Dept. Geol. Nat. R[illegible], 32d Ann. Rep., p. 621		Bassler, 1915 U. S. Nat. Mus., Bull. 92, pls. 2 and 3					Pr[illegible] Report			Thickness Nickles, 190[illegible], 1903	Thickness Bassler, 1906	Approximate [illegible] above low water [illegible] A. T. 432 ft. Bassler, 1906	[illegible] of [illegible] Straight St. section
Blue Limestone, Trenton Limestone (in part), Hudson River Group, Cincinnati Group.				Upper......	......	Madison....	....	Saluda	....	Saluda (Madison)			Saluda		Elkhorn	Richmondian			Elkhorn (Belfast)				Elkhorn	45'-50'	40'	625-665	
					....	Whitewater..	....								Whitewater				Whitewater—				Whitewater	30'-40' east side			
	Lebanon	Richmond.......	Richmond	Middle.....	Richmond		Richmond	Versailles.	Richmond	Whitewater.	Richmond group		Whitewater	Richmond	Saluda				Saluda (Madison & Fowler)		Richmond		Saluda	40'-60' west side	35'	665'-[illegible]	
					......	Liberty.....	....			Liberty			Liberty		Liberty				Liberty				Liberty	35'	35	590-[illegible]	
				Lower		Waynesville	...	Waynesville		Waynesville			Waynesville		Waynesville				Wayne ville	Blanchester, Clarksville, Ft. Ancient			Waynesville	50	[illegible]	[illegible]	
				Warren		Warren		Arnheim		Arnheim (Warren)			Arnheim		Arnheim				Arnheim	Oregonia, Sunset			Arnheim (O, S)	80'	80'	460-[illegible]	
				Mt. Auburn		Mt. Auburn		Mt. Auburn		Mt. Auburn			Mt. Auburn		Upper				Mt. Auburn				Mt. Auburn	20'	[illegible]	425-[illegible]	
	Hill Quarry (in part)	Lorraine	Lorraine.	Corryville	Lorraine	Corryville	Maysville	Corryville	Maysville (Lorraine)	Corryville		McMillan	Corryville					McMillan	Corryville (Gilbert)			McMillan	Corryville	60'	35	[illegible]	[illegible]
				Bellevue		Bellevue		Bellevue		Bellevue			Bellevue	Maysville or Lorraine	Middle		Maysville		Bellevue (Tate)		Maysville		Bellevue	20'	15	375-390	795
				Fairmount		Fairmount		Fairmount		Fairmount		Fairview	Fairmount					Fairview	Fairmount			Fairview	Fairmount	80'	50'	325'-375'	775
				Mt. Hope		Mt. Hope		Mt. Hope		Mt. Hope	Covington group		Mt. Hope		Lower				Mt. Hope (Up. Garrard)				Mt. Hope	50'	45'	280'-325'	705-713
				Upper		Upper		Garrard		Upper			McMicken		McMicken (Upper)	Cincinnatian			McMicken (Paint Lick)				McMicken	60'	60'	220'-280'	673'
	Eden (in part)	Utica	Utica	Middle	Utica	Middle	Eden	Middle Eden	Eden (Utica)	Middle		Eden	Southgate	Eden	Southgate (Middle)		Eden	Eden	Southgate	Million	Eden		Southgate	120'	120'	100'-220'	
				Lower		Lower	....	Lower Eden...	....	Lower		.....	Economy...		Economy (Lower)				Economy				Economy	80'	50'	50'-100'	
							....	(Fulton layer)	....			Utica..	Fulton..					..	Fulton		Utica		Fulton		5'	45'-50'	

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(*To be continued*)

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CONTAINS:

SYNOPSIS OF THE COLEOPTEROUS FAMILY CISIDAE (CIOIDAE) of America North of Mexico

By Charles Dury

The beetles in the above area comprised in this family exclusive of the *Rhipidandrinae*, which have been removed to the *Tenebrionidae*, are of small size, subcylindrical form, mostly of black or brownish colors, though a few species of the different heretofore described genera have red or yellow elytral maculation. They live in woody fungi of the different polyporoid kinds. Males of many of the species have variously shaped horns or processes on the head or anterior margin of prothorax, and secondary sexual marks on the first ventral segment. The number of antennal joints vary from eight to eleven in the different genera. The antennae are inserted at the anterior margin of the eyes and the terminal joints are large and form a rather loose club. Tarsi 4-jointed. The Prothorax, which has a lateral margin, is more or less prolonged over the head. Mentum corneus. Labial palpi 3-jointed. Maxillary palpi short and 4-jointed. Ventral segments five in number. The first longest. Anterior and middle coxae oval, not prominent, without trocantin. Hind coxae transverse and separated. Tarsal claws simple. But few species exceed 3mm. in length. Because of their small size and dull colors they are rather unattractive, and have been much neglected by collectors. However, if they are studied with high enough power it will be seen that they are among the most interesting of Coleopterous insects. The secondary sexual characters of the males of some of the species being quite remarkable. The North American species are of but little economic importance so far as is known, though they and their larvae are voracious feeders on the substance of the inner parts of woody fungi. They are generally gregarious and sometimes occur in great numbers. From a small piece of tough, woody polyporus broken from a log, was hatched scores of adults. They continued emerging all winter. When they first hatch they are soft and pale and require several days to acquire the dark colors of the mature

insect. They vary considerably in size and in the degree of development of sexual characters. To study them to advantage they should be clean and have antennae and foretibiae drawn out and some specimens mounted ventral side up. Some of them are very tenacious of life and require strong killing substances. The literature on the family is not very accessible. Mellie's papers are in the Annals of the Entomological Society of France, vol. vi, p. 271, 1848. Casey's paper on the North American species is in the journal of the New York Entomological Society, vol. vi, No. 2, p. 76, June 1898. Dr. E. J. Kraus has a paper, with plates, on the bicolored species, in Proc. Ent. Soc., Washington, D. C., vol. x, Nos. 1 and 2, p. 74. Prof. Blatchley gives descriptions of Indiana species (three new ones described) in Beetles or Coleoptera of Indiana. Geological and Natural History Survey. Le Conte and Horn in the classification, place the *Cioidae* in both the clavicorn and serricorn series, as they exhibit affinities in both directions. Casey considers them serricorn. W. F. Kirby in his textbook (1892) places them in his section *Teredilia.* They are widely distributed in North America, occurring from the Atlantic to the Pacific and from the gulf to Canada. At Cincinnati, Ohio, I have taken sixteen species. In Maj. Casey's paper, referred to above, he gives a table of Cioinae, p. 77, which I have modified as suggested by a much larger and more complete material, and added genera and species discovered since its publication. I am indebted to the following who have kindly loaned and presented me with specimens: H. P. Loding, Mobile, Ala.; Prof. W. S. Blatchley, Indianapolis, Ind.; C. A. Frost, Framingham, Mass.; Chas. Leng and Chas. Schaeffer, of New York; W. E. Snyder, Beaver Dam, Wis.; H. W. Wenzel, Dr. Castle, and Phil. H. Laurent, Philadelphia, Pa.; Geo. F. Moznette, Corvallis, Ore.; Dr. F. E. Blaisdell, Prof. H. C. Fall, Dr. A. Fenyes, and G. R. Pilate, of California; R. T. Kellogg, of New Mexico; W. Knaus, of Kansas; Thos. L. Casey, Washington, D. C.; Miss A. F. Braun, Cincinnati, O., and others.

GENERIC TABLE OF CIOINAE

Antennae with eleven joints 1
Antennae with ten joints 2
Antennae with nine joints 7
Antennae with 8 joints 8

1—Prosternum long before coxae. Not carinate between them. Lateral thoracic margin entire to apical angles. Maxillary palpi stout, last joint widely truncate .... **Sphindocis** (Casey.

2—Prosternum well developed before coxae. Lateral margin of prothorax entire. Last joint of maxillary palpi bluntly pointed 3

Prosternum very short in front of coxae and transversely emarginate in front 6

3—Prosternum simple or nearly so 4

Prosternum tumid or carinate along the middle 5

4—Body setose or pubescent; the vestiture erect and bristling. The anterior tibiae produced and dentiform externally at apex, though sometimes simple .... **Cis**

Body elongate and glabrous. The anterior tibiae unarmed at apex. Elytral suture margined towards tip. The head rather less deflected than usual. Head and prothorax simple in both sexes. Males with a deep rounded setigerous forea at center of first ventral segment .... **Orthocis**

5—Body glabrous or with very short, decumbent pubescence, or inclined setae .... **Xestocis**

Body opake and setose. Last joint of maxillary palpi grooved on outer side. Prothorax strongly, obliquely strigose on sides beneath. **Strigocis**

6—Body very short and stout, wider behind; pubescence stiff and erect; prosternum deeply emarginate in front .... **Brachysis**

7—Body stout, convex, coarsely cribrate and setose. Anterior tibiae strongly, obliquely produced and acute at apex .... **Plesiocis** Casey.

Body oval, small, feebly shining. Anterior tibiae produced externally at apex Epistoma transversely sulcate. Vestiture of bristling setae. Secondary sexual mark of male on first ventral segment. **Sulcasis**

Body narrow, subparallel and very small. Antennae with a 2-jointed loosely articulated club. Antennal grooves before the eyes distinct. Elytra striato, punctate .... **Dyphyllocis** Reif (Casey.
Maphoca Casey

Body narrow, cylindrical, feebly sculptured and glabrous. The anterior tibiae thickened and rounded and spinulose externally at apex .... **Ennearthron**

8—Anterior tibiae swollen, rounded and spinulose externally at apex as in ennearthron. Head and prothorax strongly modified in the male.. **Ceracis**

Anterior tibiae narrowly triangular. The external edge straight throughout and minutely spinulose. Head and prothorax not modified in the male.............................. **Octotemnus**

GENUS CIS Latreille

Antennae with ten joints. The club 3-jointed. Prosternum well developed before the coxae and rather flat between them. Lateral margin of prothorax acute to apex. Anterior tibiae either finely produced and dentiform or simple at apex. Secondary sexual modifications of the head, prothorax and first ventral segments of males of many of the species. The epistoma and frontal angles being sometimes the only parts affected. The following twelve species are described as new. Following the descriptions is a table of the eighteen species, described since the publication of Col. Casey's paper before referred to. In this paper, p. 78, he gives a tabular description of twenty-two species of the genus *Cis.* Eighteen of which are there described for the first time. Of the species enumerated in the Henshaw check list, some of Mellies' are unknown to me, and it is impossible from the descriptions or figures to tell exactly what they are, and only an examination of the types can positively decide, and it is possible that some of the species described since may be synonymous with some of them. Casey's species described in the paper above referred to (the types of which I have examined) are mostly strongly characterized species. I have yet some species that I think are undescribed, but I await more specimens before describing them.

Cis arizonae, n. sp.

Form stout, elongate, cylindric. Color dark piceous, submetallic, shining pubescence, very sparse and inconspicious, arranged without order. Clypeus produced into two flat, slightly upturned processes. Front flat. Prothorax one-fourth wider than long, with base truncate. Apex in male produced into two stout, rounded processes, obtuse at tip, and the

emargination between them evenly rounded. The apex of the female prothorax being slightly emarginate. The punctuation of prothorax is closer and finer than that of elytra, which are nearly twice as long as wide and rather coarsely and deeply punctured. The first abdominal segment of male without fovea or other mark. Length 4-30 mm. This is the largest species I have seen and was collected by myself on Polyporus fungus in Madera Canon, Santa Rita Mountains, Arizona, July 23, 1915. Twelve specimens.

Cis lodingi, n. sp.

Body stout and thick; very convex, suboval in outline from above; piceous in color. Pubescence yellow, bristling, moderate in length, subdecumbent. Head sunken, flat in front, with a shallow transverse impression across base of epistoma, subfoveate at middle. Epistoma produced with margin reflexed, subangulate in front of each eye, angulate and deflexed at middle. Surface of head alutaceus and with large variolate punctures. Antennae with third joint about as long as fourth and fifth together. Tenth joint longer than wide and pointed at tip. Prothorax very high and projecting over head at apex. Strongly margined. Apex of prothorax slightly emarginate at middle. Punctures variolate, sparse and shallow. Scutellum small and transverse. Elytra slightly wider than prothorax and not twice as long as wide. Bristles not serial in arrangement. Elytral punctures rather coarse and deep. Humeri small, but prominent. Anterior tibiae flattened, carinate on its outer edge, produced at apical angle, terminating in a sharp spur. Prosternum long before coxae; wide and flat between them. Size, 2-08 x 1-01 mm. The above description was drawn from the male which has no secondary sexual mark on first ventral segment. The female does not differ much. Because of its thick body and sunken head this species resembles some *Cryptocephalus* in outline when viewed from the side. Eleven specimens from Mobile, Ala., collected by Mr. H. P. Loding, to whom it is dedicated.

Cis bicolor, n. sp.

Elongate, cylindrical. Colors dark brown and ochre yellow. Head with front margin of epistoma rounded and with the transverse suture deep and strong. Front concave. Antennae 10-jointed. Prothorax dark brown in color, finely, densely punctured. Apical margin simple. Hind angles prominent, wider at base than elytra. Elytra with a transverse dark brown basal band for one-third their length. The brown extending along elytral margin nearly to apex. The apical two-thirds of elytra ochre yellow. Each elytra with an elongate spot of brown in front of declivity. Vestiture of dense, conspicious setae, arranged without order. Elytra narrower than prothorax and fully twice as long as wide. Two males. The first ventral segment has a large flat fovea, whose surface is finely papillose. Length 2 mm. Tybee Island, Ga. H. W. Wenzel, who has one male, and my own collection, one male. The female has not been seen.

Cis julichi, n. sp.

Form elongate, rounded. Color castaneous, with legs and antennae pale testaceus. Eyes moderate and prominent. Epistoma emarginate at middle in male, with two widely separated blunt angles. The female epistoma is squarely truncate. Third joint of antennae elongate, slender, much longer than fourth. Fifth as long as wide, sixth and seventh wider than long. Punctures single. Vestiture consisting of strong bristles, arranged without order. Prothorax as wide as elytra, with apex simple in both sexes, strongly margined at sides and base. The apex of foretibia is squarely truncate and simple. The fifth ventral segment of male is very short (longer in female) and there are no sex marks on first ventral segment. Length 1.75 mm. New York City. Collected by the late Wm. Julich, to whom it is dedicated. Received from Chas. Leng, who has Cotypes. Six specimens examined.

Cis blatchleyi, n. sp.

Piceous shining. Body rather short and stout, sparsely covered with pale setae, not serially arranged. Punctures

coarse. Head flat. Epistoma reflexed and produced into two small denticles at middle, emarginate between them. Antennae 10-jointed. Eyes not prominent. Prothorax slightly produced at apex into two feeble angles, emarginate between them. Four specs. Length 1.75 mm. Dunedin, Fla. W. S. Blatchley to whom it is dedicated.

Cis cylindricus, n. sp.

Elongate, cylindrical. Black, very like *Cis hystricula* Csy., but differs as follows: Head larger, elytral punctures, very coarse and deep, setae coarse and sparse. Clypeal tubercles porrect. Male with fovea at middle of first ventral segment. I compared this species with the type of *hystricula* in Col. Casey's collection. He agreed with me that it was not the same as that species. Length 2 mm. Umatilla Co., Oregon. Abundant. G. F. Moznette.

Cis wenzeli, n. sp.

Elongate, cylindrical. Elytra piceous. Prothorax piceo castaneous. Punctures dual and all rather fine. Setae fine, subdecumbent, inconspicuous. Epistoma truncate, feebly angulate each side in front of eyes. Prothorax, with sides parallel, hind angles prominent, apex simple in both sexes. Beneath, the male has first ventral simple. Anterior tibia feebly everted externally at apex. 2 mm. Del. Co. Penn. Four specimens. H. A. Wenzel, to whom the species is dedicated. Taken in abundance in *Polyporus versicolor*.

Cis huachucae, n. sp.

Form oval; short, broad and very convex. Color pale (immature). Punctures shallow, dense. Vestiture of long, stiff, erect sharp-pointed bristles. Epistoma produced with a tooth-like angle in front of each eye and two smaller teeth at middle. Front flat. Prothorax wider than long; sides strongly rounded and convergent at basal and apical angles. Apex produced into two small, gradually formed processes, very close together. A shallow line running from base to apex at middle. Elytra as wide as prothorax and less than twice as

long as wide. A poorly defined fovea on first ventral segment Length 2.25 mm. One male specimen. Huachuca Mountains, Arizona. Miller Canon. This species comes nearest vitula Mann, but is very distinct. Type in collection of H. W. Wenzel.

Cis frosti, n. sp.

Brown; very broadly oval, convex, densely punctured, closely covered with short yellow bristles. Head flat, with shallow forea in middle, clypeus prolonged each side into two flat triangular processes, rather deeply emarginate between them. Prothorax wider than long, apex slightly emarginate at middle and prominent, projecting over the head. Front angles blunt, but very prominent. Side margins broad and strong. Base feebly margined. A shallow impressed longitudinal line at middle. Elytra very broad and ogivally rounded to apex. Length 2 mm. Width .09 mm. Orono, Maine. This is the broadest species for its length I have seen. I have but one male, presented by Mr. Chas. A. Frost, Framingham, Mass., to whom the species is dedicated.

Cis floridae, n. sp.

Form oblong oval. Vestiture fine and long. Epistoma produced into two triangular processes, deeply emarginate between them. Prothorax with sides subparallel, converging towards apex, which is produced into two porrect, flat, rather broad, gradual processes. Punctures fine and moderately dense. Elytra slightly over one and one-half times as long as wide. Punctures coarser than those of prothorax. First ventral with a round fovea on posterior half. The female has epistoma and prothorax simple and lacks the ventral fovea. Color pale castaneous. Length 2 mm. Key West, Florida. A pair only.

Cis serricollis, n. sp.

Broad, oval in form. Color dark brown. Vestiture of short bristles, conspicuous, arranged without order. Head with epistoma subtruncate in front, reflexed each side and narrowly deflexed at middle. Front flat and sparsely punctured. Pro-

thorax wider than long; sides strongly margined. The edge finely serrate, with serrations that resemble elongate beads. Punctures dense and fine. Elytra one and one-half times as long as wide, with punctures dual and dense, the larger ones shallow and shining at bottom. Beneath densely punctured, the ventral segments coarsely so. The anterior tibiae simple at apex. Males without modifications of prothorax or first ventral segment. Length 2-50 mm. Width 1 mm. Three specimens. Linn Co., Oregon. G. F. Moznette.

Cis pusillus, n. sp.

Elongate, oval. Piceo castaneous, shining. Antennae, tibiae and tarsi pale. Vestiture very minute, scant and inconspicuous. Head with epistoma emarginate at middle, with short blunt processes each side. Antennae 10-jointed. Prothorax with strong uniform punctures. Apex with slight emargination at middle. Punctures of elytra dual, the larger ones foveiform, shallow and shining, the smaller sparse scattered and bearing minute bristles. Anterior tibiae slightly everted externally at apex. Male with a fovea just posterior to middle of first ventral segment. Length 1.40 mm. Two specimens. Prof. W. S. Blatchley, Dunedin, Fla. This minute species looks very unlike a typical *Cis*, but the difference in facies is hardly of generic importance.

Cis crebberima, Mellie

The male has a fovea at middle of first ventral segment. The species is quite variable in size and degree of convexity. Otherwise the description covers the points of structure.

Cis falli, Blatchley

Prof. Blatchley has loaned me his Indiana types of this species, which seems to be abundantly distinct. In addition to the diagnostic points given in the original description (Coleoptera or beetles of Indiana, p. 898). From a fully developed male I note that the last joint of maxillary palpi is truncate at tip and somewhat securiform. The third antennal joint is

as long as the fourth and fifth together. The epistoma has two small teeth or angulations on each side of middle, with a strong emargination between them. The foretibiae are produced externally at tip into a point. The male has a sharply defined fovea on first ventral segment. Taken also at Cincinnati, Ohio and Mobile, Ala.

Cis fuscipes, Mellie

The species that is known as fuscipes in collections and was so considered by LeConte, Horn and the older coleopterists, is a stout, rounded piceous species, with pale legs and antennae. The punctures are dual and surface rugulose. The vestiture of conspicuous bristles is arranged in regular rows. The epistoma is simple but reflexed and slightly truncate or feebly rounded in front. The prothoracic apex is rounded and rather prominent in both sexes. The males have no mark on first ventral segment. In size the specimens vary from 1-08 to 3 mm. Specimens have been seen from nearly every state in the United States, even California (Alameda Co.). At Cincinnati, Ohio, it is very abundant and lives in various Polyporoid fungi. No other *Cis* is as common and widely distributed as this. A comparison with the type only will decide if this is the species described as *fuscipes* by Mellie. The form considered *chevrolati* in collections seems to be a variety of the variable *fuscipes*. The species described as *carolinae*, Casey is said to differ in having the third and fourth joints of the antennae equal in length. Specimens from Cincinnati, identified as *carolinae* by Col. Casey, have this character, but I find it a variable one. Otherwise I can see no difference between it and *fuscipes*.

Cis impressa, Casey

Journal, New York Ent. Soc., vol. vi, No. 2, p. 79. This is an abundant species in various localities in California, Oregon, Idaho, and seems to extend across the country as far as East Machias, Me. I also have specimens from Swansea, Mass. I can not see any constant specific difference between

the eastern and western forms. The proportional length of antennal joints is variable, particularly between males and females. They have, in the male, a fovea at middle of first ventral segment. In a male, from Maine, this fovea is concealed by a tuft of yellow hairs. These hairs seem to be wholly or partly removed in other specimens. The females closely resemble *Cis fuscipes.* The males are easily recognizable by the large impressed space at apex of prothorax.

TABLE OF CIS (DESCRIBED SINCE 1898)

Bicolored species, with well-defined markings on prothorax and elytra. 1

Piceous or brown-colored species (paler when immature), without well-defined markings.. 2

1—Straw yellow, maculate with piceous. Epistoma not punctured, opake. Slightly elevated and subquadrate. Elytra with black at base and transverse band at apical, third extending along suture to apex. Length 1-02 mm. Cayamas, Cuba. Florida. **superbus** Kraus

Brownish yellow, maculate with blackish. Epistoma sparsely punctured, broadly semielliptical. Elytra black at base and with two spots posterior to middle. Length 1-05 mm. Victoria, Texas. **bimaculatus** Kraus

Dark brown, maculate with yellow. Epistoma, with deep transverse groove at suture. Elytra brown at base, with apical two-thirds yellow; two elongate brown spots or clouds in front of declivity. Length 2 mm. Subopake, Tybee Island, Ga..........**bicolor** Dury

2—Larger species 2.50 mm. or over in length. Punctures single. Vestiture not serial in arrangement.............................. 3

Medium sized species not over 2 mm. in length.................. 4

Very small species less than 1.50 mm. in length................. 5

3—Very large and convex. Elytral punctures fine and dense. Male with strong secondary sexual characters on prothorax and first ventral segment. Epistoma, with two flat, sharp processes. Length 4-30 mm. Santa Rita Mountains, Ariz..............**arizonae** Dury

Smaller, very convex. Elytral punctures sparser. Male sexual characters on epistoma, which is angulate and deflexed at middle. Length 2.08 mm. Mobile, Ala......................**lodingi** Dury

Short, broad, convex. Vestiture fine, long and conspicuous. Male sexual marks at apex of prothorax and first ventral segment. Epistoma with two large, blunt, triangular processes. Length 2.06 mm. Indiana—Ohio....................................**cornuta** Blatch.

Shaped like **cornuta.** Vestiture coarser. Epistoma quadridentate. Length 2.25 mm. Huachuca Mountains, Ariz......**huachucae** Dury

Elongate, convex, shining black. Vestiture scant, inconspicuous. Elytral punctures dual, strong and dense. Epistoma emarginate at middle, with a small denticle each side. Length 2.02 mm. Indiana, Ohio and Alabama............................**falli** Blatch.

Broad, oval; brown in color; punctures dual. Vestiture abundant, conspicuous. Prothoracic margin serrate. Epistoma deflexed at middle. Length 2.50 mm. Linn Co., Oregon.....**serricollis** Dury

4—Elongate; smaller and more depressed than **falli**. Piceous in color. Allied to that species. Length 2 mm. Indiana and Alabama. **confusus** Blatch.

Elongate, cylindrical, black. Elytra with coarse, deep, single punctures. Vestiture short and bristling. Epistoma of male with porrect tubercles. Near **hystricula** Csy., but differs in the larger head and coarser punctures. Length 2 mm. Umatilla Co., Oregon. **cylindricus** Dury

Elongate, cylindrical, piceous. Vestiture fine and subdecumbent. Punctures dual. Epistoma truncate, feebly angulate each side in front of eyes. Length 2 mm. Delaware Co., Penn....**wenzeli** Dury

Elongate, rounded in form. Color castaneous. Punctures single. Epistoma emarginate at middle, with widely separated blunt angles each side in the male. Squarely truncate in the female. Length 1-75 mm New York City..................**julichi** Dury

Oblong, oval. Epistoma strongly produced into triangular processes. Prothorax with subparallel sides. Length 2 mm. Key West, Fla. **floridae** Dury

Short and stout. Piceous, shining. Vestiture sparse and inconspicuous, arranged without order. Epistoma reflexed and produced into two small denticles at middle. Length 1.75 mm. Dunedin, Fla. **blatchleyi** Dury

Very broad, oval. Brown in color. Vestiture of conspicuous yellow bristles. Epistoma prolonged into flat triangular processes each side, deeply emarginate between them. Length 2 mm. Framingham, Mass.......................................**frosti** Dury

5—Elongate, oval. Pico-castaneous, shining. Vestiture minute and sparse. Epistoma emarginate at middle, with blunt processes each side. Length 1.40 mm. Dunedin, Fla..........**pusillus** Dury

ORTHOCIS, Casey

Orthocis longula, n. sp.

Form very narrow and elongate. Shining, rufo piceous in color. Punctures coarse, legs and antennae pale. Head with the clypeal margin slightly angulate, each side in front of eye

and strongly reflexed at sides, but not so at middle. Eyes moderate in size, but very convex and prominent. Antennae with ten joints. Third joint long and slender, fourth not as long as third, also slender. Fifth and sixth short, slightly longer than wide. Seventh beadlike, not longer than wide. The three joints comprising the club as long as wide. Prothorax about as long as wide. Elytra two and one-half times as long as wide. The Prothorax is subquadrate in form and as wide at front angles, which are right angles, as at base. Sides straight. Ligula narrow and strongly concave along middle. Length 1-.06 to 2.08 mm. Five specimens. Pennsylvania and Florida. This species has the head flatter than *Orthocis punctata* Csy., but the punctuation of the two species is about the same. It varies much in size. *Orthocis punctata* Csy. also seems to vary much in size. Specimens from North Georgia being very large. 3-02 mm. in length. New Jersey specimens are 2-5 mm., while one from Michigan is but 2-02 mm. The strength of the sutural margin also varies. One from Tybee Island, Ga., has it almost obsolete. I have not taken it at Cincinnati, Ohio.

Orthocis aterrima, Csy.

I have only seen the type of this species. There were no specimens in any of the California collections examined. It is from Alameda County, California. The five species of *Orthocis*, which genus is described in Casey's paper, before referred to, p. 84, tabulate themselves as follows:

Elytra unicolorous.. 1

Elytra bicolored.. 2

1—Ligula broad and flat. Third antennal joint nearly or quite as long as the next two combined. Georgia, Michigan, New York, New Jersey and Massachusetts......................**punctata** Mellie

Ligula narrow and strongly concave. Third antennal joint as long as the next two, nearly as long as the next three combined. Pennsylvania and Florida...........................**longula** Dury

Ligula narrow and convex. Third antennal joint distinctly shorter than the next two combined. California...........**aterrima** Casey

2—Elytra straw yellow; maculate with black in shape of band from base to apex along suture, with cross bands to side margin, at base and middle. Third antennal joint as long as next three combined. Key West, Florida. 1-07 mm. . . . . **huesanus** Kraus

Elytra yellow, with a transverse black band at base and another at apical third. Third joint of antennae much shorter. Key West, Fla. 1-03 mm. . . . . **pulcher** Kraus

XESTOCIS, Casey

Journal of New York Entomological Society, No. 2, vol. vi, 1898, p. 85.

Xestocis singularis, n. sp.

Oblong, oval, glabrous, shining. Piceo castaneous in color. *Male*—Epistoma reflexed, angulate at sides, slightly marginate at middle. Front deeply concave, smooth. Antennae 10-jointed stout, third joint as long as fourth and fifth together, fifth, sixth and seventh very transverse. First two joints of club as long as wide, last joint longer. Eyes moderate in size, but very prominent. Prothorax as long as wide, wider than elytra, sides arcuate, hind angles rounded, strongly margined at base and sides. The front angles rather acute and extending across front as a carina into the porrect blunt horns or processes. These horns are of very singular shape, being curved upwards and outwards at tip, with a thick carina running lengthways with the horns. The upper edge of this carina being convex and highest in the middle. Between the horns, which are widely separated, is a shining subquadrate depression. At base of horns on outer side it is strongly strigose. It is also strigose at sides and across base of prothorax. Punctures rather fine and uniform. Elytra narrower than prothorax and less than twice as long, substriate. Punctures dual. Large and foveiform ones in rows, and minute ones scattered along interspaces. Beneath the prothorax is long before the coxae, which are large and prominent, with a sharp carina between them. The anterior tibiae are flattened and carinate on outer edge, with a produced apical angle, rounded and finely

denticulate. The first ventral segment has a rounded, finely punctate fovea, with a row of long yellow hairs, springing from its anterior margin and pointing backward over it. Length 2-02 to 1-08 mm. The female is smaller and lacks horns and ventral fovea and her ventral segments are pale. Eight specimens. Cincinnati, Ohio, Kentucky, Alabama and Tennessee. (Cumberland Gap). Specimens in National Museum with larvae, from District of Columbia.

Xestocis moznettei, n. sp.

Oblong oval. Thorax piceous, elytra brown, with a large reddish blotch at humeri and another near apex. Basal joints of antennae and legs paler. Punctures dual, the smaller ones bearing short, pale bristles, not serial in arrangement. Head has epistoma emarginate at middle, on each side of which the margin is reflexed into triangular processes. Front with a shallow foveate depression. Prothorax evenly and finely punctured; sides arcuately rounded and strongly margined around base. Elytra twice as long as prothorax, with the larger punctures substriate in arrangement. Beneath the prosternum is strongly tumid between coxae. Males have a rounded fovea on first ventral segment. The females lack this fovea. Average length 2 mm. Fifty specimens. Bred from Polystictus. Corvallis, Oregon, March 10, 1915. Geo. F. Moznette.

Xestocis davisi, n. sp.

Male. Broad, oval. Rather pointed before and behind. Shaped like *opalescens*. Piceo castaneous in color. Clypeus biangulate. Front concave. Prothorax wider than long, finely, closely punctate. Apex produced into a short process, emarginate at tip. Elytra one and one-half times as long as wide; finely, deeply, punctate. Conjointly pointed behind. Beneath with a fovea on first ventral segment. Length 1-50. Width 0-6 mm. Female lacks fovea and process of prothorax. Three specimens. Staten Island, N. Y. Named in honor of Wm. T. Davis, who knows more of the faunae of Staten Island than any one I know of.

Xestocis quadridentatus, n. sp.

Elongate, suboval, shining. Piceo castaneous in color, with pale legs. The male has the epistoma strongly quadridentate and reflexed; front of head concave. Maxillary palpi, with last joint large, oval and bluntly pointed. Antennae 10-jointed. Third joint slender and longer than fourth. Fourth, fifth and sixth decreasing in length and increasing in thickness. Three-jointed club loose, with the terminal joint rather pointed. Prothorax about as wide as long. Sides arcuate and margined as is base. Apex produced into two triangular flat horns. Punctures strong, deep, uniform and close set, as are those of elytra, which are as wide as prothorax and one-half longer than wide, bristling with pale pubescence, arranged without order. A small, deep fovea at middle of first ventral segment. Females are without the epistomal teeth and ventral fovea. Length 1.50 to 2 mm. Twenty-two specimens. Framingham, Mass. Mr. Chas. A. Frost.

Xestocis castlei, n. sp.

Suboval in form, rufopiceous in color. Moderately shining. Horns, head and legs pale. Vestiture composed of rather dense, short, stout, yellow bristles, not at all serial in arrangement. Male. Head broad; eyes small. Front flat, with epistoma reflexed and produced each side into two widely separated sharply pointed horns, which are curved upwards and carinate beneath from their base to apex. Antennae 10-jointed. First joint very thick, second slightly more than one-half as thick and shorter. Third, fourth, fifth, sixth and seventh gradually decreasing in length and much narrower than second. Seventh very transverse. Three-jointed club about as long as the preceding together and with the joints feebly subquadrate. Prothorax as long as wide, sides arcuate and margined to apical angles, which are not prominent. Base truncate and finely margined. Apex produced into two prominent triangular flat horns. Elytra slightly narrower at base than prothorax, with sides visibly arcuate to the ogivally rounded apex, and less than twice as long as wide. Suture very finely beaded. Punc-

tures coarser and sparser than those of prothorax. Beneath, prosternum well developed before the coxae and sharply carinate between them. Anterior tibiae slightly thickened and rounded at tip. A circular fovea at center of first ventral segment. Female lacks fovea and horns. Length 1-06 x 06 mm. Cincinnati, Ohio. One hundred specimens. Named in honor of Dr. Castle, of Philadelphia, Pa., a veteran coleopterist and lover of nature.

Xestocis levettei, Casey

Journal New York Ent. Soc., vol. vi, p. 85. I might add to the description above cited, that the punctures are dual, consisting of larger circular ones, shallow and shining at bottom, and smaller deep ones which bear minute hairs. The male has a large fovea on first ventral segment, which is fringed with long yellow hairs. The species has a very wide distribution. I have specimens from Canada to Florida, and Newfoundland and New Hampshire to Ohio and Indiana. At Cincinnati it is very abundant.

Xestocis opalescens, Casey

To description in paper above cited, page 86. I add that the side margins of prothorax are wider behind (subexplanate), and a strongly developed male has the epistoma produced into two broad processes or horns, obtuse at tip. The prothorax at apex is also produced into two broad recurved horns. At posterior middle of first ventral segment is a large round pubescent fovea, with a sharp, deep groove around it. Terminal joint of maxillary palpi thick, oval and bluntly pointed. The anterior tibiae are sharply angulate externally. I have examined the type which seems to be a less strongly developed male. The type is from Pennsylvania. It occurs also at Washington, D. C., Virginia and Cincinnati, Ohio, but does not seem to be anywhere common.

TABLE OF XESTOCIS

Body glabrous.. 1
Body clothed with short pubescence or bristles...................... 2
1—Clypeus bidentate in male. Prothorax simple or rounded in both sexes. Eastern United States.....................**levettei** Casey

Clypeus bidentate in male. Prothorax armed in male. Body short, broad, shaped and proportioned as in opalescens, but smaller and glabrous. Staten Island, N. Y. .... **davisi** Dury

Clypeus monocerate in males. Apex of prothorax, with two long slender porrect processes. Rhode Island to Alabama... **miles** Casey

Clypeus reflexed, angulate at sides. Prothorax, with two thick, porrect, blunt horns, which are carinate above. Ohio. **singularis** Dury

2—Vestiture very fine and inconspicuous. Side margin of prothorax very wide; subexplanate. Pennsylvania, Ohio and Virginia. **opalescens** Casey

Vestiture composed of very fine decumbent, inconspicuous pubescence. Body bicolored. Elytra substriate. Prothoracic side margin narrower. Oregon .... **moznettei** Dury

Vestiture not conspicuous. Composed of fine simple subdecumbent hairs. Prothoracic side margin narrower. Elytra not substriate. British Columbia to Oregon.................... **biarmata** Mann

Vestiture composed of very conspicuous squamules. Clypeus quadridentate. Massachusetts .... **quadridentatus** Dury

Vestiture composed of coarse, stiff, suberect squamules. Epistoma in male biangulate and with apex of prothorax subangularly produced and rounded, with tip very narrowly sinuato-truncate. Pennsylvania.................................... **insolens** Casey

Vestiture composed of rather dense, short, stout yellow bristles. Epistoma reflexed and produced into two widely separated horns, sharply pointed. Apex of prothorax produced into two prominent triangular flat horns. Cincinnati, Ohio.............. **castlei** Dury

STRIGOCIS, n. genus

Body elongate, subcylindrical. Vestiture, consisting of short, stiff inclined setae. Maxillary palpi, with the terminal joint truncate at tip. The outer edge thickened and grooved, the inner side thin and blade-like. Antennae 10-jointed. The anterior margin of epistoma produced in both sexes. Prosternum long before coxae, carinate at middle, strongly and obliquely strigose. Front tibiae flattened externally; produced and spinulose at apex. Elytral suture sharply margined. This genus is founded on a species that will not fit any so far defined, having a combination of their characters. Related to *Orthocis* in the margined elytral suture and to *Xestocis* in prosternal carination.

Strigocis opacicollis, n. sp.

Elongate, oval. Color piceous. Legs and antennae pale. Thorax opake and alutaceus, not closely, but rather strongly punctate. As wide at base as apex. Front angles prominent; sides feebly arcuate. Strongly margined at base and sides to apical angles. Elytra more shining than prothorax and nearly twice as long. Moderately and uniformly punctured, each puncture bearing a light colored bristle, arranged without order. The humeral callus very prominent, shining and resembling a rounded tubercle. Suture finely margined more strongly behind. In the male the clypeus is projected forward in a thin broad bifercate process, behind which the front is deeply excavated into a rounded depression. The apical edge of prothorax is prolonged into an abrupt laminar process, notched at middle. There is a circular fovea at middle of first ventral segment. The female lacks this and also the prothoracic process. Beneath both sexes have the oblique strigosity before described. Fully developed males are 1-8 x 07 mm. in size. Females and depauperate males are smaller. Twenty-four specimens. Cincinnati, Ohio, Mobile, Ala., and New Jersey.

SULCACIS, n. gensus

Small size bristling with erect setae. The epistoma has the margin subtruncate across its front, with a strong sulcation at its base, between the lower border of the eyes. The apical margin of prothorax is rounded and simple in both sexes. The maxillary palpi are large, elongate and bluntly pointed. The prosternum is broadly excavated in front and flat between coxae. The antennae are 9-jointed. The anterior tibiae are produced and everted at apex. The males have sexual marks on first segment. The structure of this genus recalls *Plesiocis* Csy., but the antennal club lacks the large, sensitive pores filled with white spongy pubescence. It is a rather feebly characterized genus. I have seen two species in the above genus. They are:

Sulcacis lengi, n. sp.

Oblong, oval; cylindric in form; piceous black, subopake. Bristling with pale setae, arranged without order. Head sparsely punctate; flat in front, with a well-marked sulcation across clypeus, which is slightly produced in front. Antennae 9-jointed, with a 3-jointed club. Club joints rounded, slightly transverse, with a deep fovea on each side. Third joint elongate, as long as the fourth and fifth combined. Sixth very short, much wider than long. Prothorax as long as wide. Sides rounded and margined, as is base. Apex rounded and simple in both sexes. Elytra one and one-half times as long as wide; widest behind middle and evenly rounded to apex. Beneath the prosternum is flat between coxae and strongly transversely excavated in front. The male has a round fovea on first ventral segment, with a row of bristles around it, pointing inwards. Length 1-08 mm. Vermont. From Chas. Leng. Cincinnati, Ohio, abundant. The excavated prosternum points strongly towards *Brachycis*. It also resembles *Plesiocis*, the type of which is a California species.

Sulcacis niger, n. sp.

A species allied to *lengi*. Jet black and more shining and of more cylindrical form. Punctuation and bristles coarser and sparser. The bristles white in color. Prosternum narrower between coxae. Antennal joints differently proportioned, the third joint being as long as the fourth, fifth and sixth combined. The seventh and eighth joints wider than long. The ninth joint only being circular. Length 1.05-08 mm. Three specimens. Southern Illinois. I have received from Mr. H. W. Wenzel, of Philadelphia, a species taken by him in Del. Co., Pa., that is perhaps a race of the above. It has finer punctuation and more abundant bristles, which are more yellow in color. More specimens from intermediate points may show that there is only one species.

Brachycis brevicollis, Csy.

To the original description, Journal New York Ent. Soc., p. 86, vol. vi, I add the following: The male has a large circular cicatrix like fovea, a little posterior to the middle of the first ventral segment. The original generic diagnosis says "the side margin of prothorax is obsolescent at apical angles." In seventy-five specimens examined, this margin is sharp and strongly developed around these angles. The front tibiae are produced into a spur at apex and the middle and hind tibiae are obliquely truncate and spinulose. My specimens average 1-07 x 0-8 mm. in size. North Illinois and Mobile, Ala., from which latter place I have bred them from fungus sent by Mr. Loding. They are very abundant in Alabama, but I have not yet found them at Cincinnati.

Plesiocis cribrum, Casey

The description by Casey evidently refers to the female. Some of my smaller females fit this description closely. The males have strong secondary sexual characters. The reflexed epistoma is quadridentate; the prothorax is produced at apex into two short processes, with a broad, shallow emargination between them. The first ventral segment has a sharp, small, round fovea at middle. The females range in size from less than 2 to 3.50 mm. Fourteen specimens. Truckee, Cal., also Humboldt and Sonoma Counties.

ENNEARTHRON, Mellie

Ennearthron compacta, n. sp.

Short, round, thick and compact. Color piceous black, glabrous and shining. Head with epistoma rounded and front transversely sulcate. Prothorax about as wide as long. Sides rounded and margined around front angles, which are prominent. Apex produced into a thin lamelate process, emarginate at tip. Punctures very uniform, sparse and fine. Elytra one and one-half times as long as wide, with punctures closer and

much larger than those of prothorax. Beneath the outer apical angles of anterior tibiae are rounded and spinulose. First ventral segment of male with a circular fovea on posterior half. Length 2 mm. Width 1 mm. Key West, Fla. Bred from *Fomes marmoratus*, Berk., C. G. Lloyd, And three specimens from Round Mountain, Texas, which do not differ from the Florida specimens, received from H. W. Wenzel. This species is the broadest for its length of any I have seen. It deviates somewhat in generic characters, but they are hardly sufficient for another genus.

Ennearthron oregonus, n. sp.

Elongate, cylindrical, slender in form, shining. Head and prothorax red; elytra piceo castaneous in color. Male—Head with epistoma reflexed and produced into a rather long, broad, lamellar process, slightly emarginate at tip. Front with a strong transverse shining concavity. Prothorax about as long as wide. Alutaceous finely and sparsely punctate. Apex produced into a very thin, upturned, gradually formed process, strongly emarginate at tip. Elytra about two and one-half times as long as wide and of same width as thorax. Punctuation slightly rugose and coarser and more dense than that of prothorax. Beneath the apex of front tibiae are rounded and spinulose at apex externally. The first ventral has a small, round fovea on posterior half at middle. Length 1-50 mm. Corvallis, Oregon. Mr. Moznette. Allied to *Convergens* Csy. a large series may show the two to be identical. Two males.

Ennearthron coloradense, n. sp.

Elongate, dark piceous, shining. Head, legs and antennae pale, and the latter very elongate and 9-jointed. The third joint as long as the fourth, fifth and sixth together. Allied to *thoracicorne*, which has the third antennal joint only equal to the next two. Elytra twice as long as prothorax and slightly wider; closely and finely punctate. Prothorax alutaceus, deeply and evenly punctured, the punctures being smaller than those of elytra. Only males were seen. The epistoma

being strongly reflexed in trapizoidal process, which is emarginate above. Prothoracic process abrupt and deeply emarginate at middle. A circular fovea at posterior border of first ventral segment. The other segments transversely strigose. Length 2-04 mm. I took this species at Grand Lake, Middle Park, Colo. Only males were seen.

A subspecies of the above was taken in Grant Co., New Mexico. It is about the same size and proportions, but differs in having an impressed space behind the prothoracic process, and having this process more gradually formed. The prothorax is always red and the posterior part of elytra is always with traces of this red color. Ten specimens. Both sexes.

Ennearthron thoracicorne, Ziegl

An examination with high power shows that each joint of the antennal club has a large fovea and a small denticle on the outside of joint. The third joint is as long as the first and second.

TABLE OF ENNEARTHRON

Species with elytral maculation. bicolored.............................. 1
Species with elytra unicolored.................................... 2

1—Prothorax mostly dark. Elytra with an irregular narrow transverse pale band at middle. Florida, Georgia, Texas and Virginia. **transversatum**

Prothorax dark medially, elytra with a broad, transverse, dusky band at base and two indistinct dusky spots at apex. Florida. **pallidum**

Prothorax with anterior half brownish. Elytra with transverse piceous band that narrows towards scutellum. Apex of elytra dusky for about one-third their length. Cuba.....**annulatum**

2—Male with a long, single, slender, erect clypeal process. Size very small..10

Males with the clypeal margin reflexed. Thoracic process bidentate.. 3

3—Males with the thoracic process longer, narrower and more approximate. Punctuation very fine, that of elytra confused in arrangement..4

Males with the thoracic process shorter, more widely separated and more lamellarly triangular; punctuation stronger............. 6

4—Apex of prothorax rather feebly impressed behind the processes. Form slender; cylindric.................................... 5

Apex of prothorax strongly impressed behind processes. Punctures of elytra finer than those of prothorax. Elytra less than one-half longer than wide. Texas and Louisiana................**piceum**

5—Elytra fully one-half longer than the prothorax; slender. Punctures very fine, elytra slightly rugose. Canada to Florida. .**thoracicorne**

More slender than *thoracicorne*. Processes of thorax longer and less divergent. Thorax of female more strongly extended over head. Disk of thorax alutaceus and more evenly and coarsely punctured than *thoracicorne*. Indiana.............................**oblongus**

Elytra very short and strongly cuneiform; very much less than one-half longer than the prothorax, which is not quite as long as wide. Elytral punctures sparse and very minute. Morgan City, La..**laminifrons**

6—Thoracic process of male very abruptly formed.................... 7

Thoracic process of male not abruptly formed, its sides merging gradually and obliquely into the sides of prothorax.............. 8

7—Elytral punctures rather coarse. Thoracic process one-half as wide as elytra. Clypeal process very broad. California (Southern). **grossulum**

Elytral punctures close set. Angles of clypeal process scarcely rounded. Punctures generally very feebly subserial in arrangement. Color blackish. California (especially northern coast regions)..**californicum**

Elytra with feebly impressed lines. Punctures feebly subserial in arrangement. Piceous. Elytra paler. Prothoracic process rather short. Lamelliform.. 9

8—Prothoracic punctures sparse; angles of clypeal process rounded. Color more or less rufotestaceus, the elytra sometimes blackish towards base. California..............................**discolor**

Prothoracic punctures fine, dense. Form short, broad and compact. Epistoma rounded in front. Length 2 mm. Width 1 mm. Key West, Fla., Round Mountains, Tex...................**compacta**

Narrowly cylindric, blackish, elytra rufescent at tip. Clypeus with the sides strongly convergent, the apex broadly sinuato-truncate, with angles blunt. California........................**convergens**

Elongate, cylindric. Head and prothorax red. Elytra blackish. Head with the front strongly concave. Angles of processes sharp. Corvallis, Ore...**oregonus**

Larger, elongate, cylindric, black, very shining. Reflexed process of epistoma very prominent; deeply sinuate; angles sharp. Process of prothorax long and deeply emarginate at tip. Color either piceous or with elytra piceous and prothorax red. Middle Park, Colo., Grant Co., New Mexico.......................**coloradense**

9—Clypeus only moderately reflexed; its apex broadly truncate. Prothoracic process abruptly formed, rather short, lamelliform, with a triangular incisure at middle. Elytra substriate. Florida and Alabama. .... **pullulum**

10—Very small. Punctures excessively minute. Male, with clypeal process very long and narrow, with its apex rounded. Key West, Fla. .... **unicorne**

thoracicorne, *piceum* and *oblongus* are very close, and perhaps but one species, as the characters given to separate them vary. I include the Cuban *annulatum* as it will perhaps be found in Florida. Several of the California species are very close to each other and may prove to be the same. Tables founded on male secondary sexual characters are bad, but with so many closely allied species where characters are so feeble, it seems impossible to do otherwise.

CERACIS Mellie

Ceracis schaefferi, n. sp.

Piceo castaneous in color. Allied to *sallei*, but is smaller and does not have the elytra pale and blackish towards base. Prothoracic punctures sparser than in *sallei*. Elytral punctures dual and much coarser and deeper than in that species. Length 1.50 mm. Brownsville, Texas. Four specimens. Two males and two females received from Charles Schaeffer, Brooklyn, N. Y. The color of *sallei* when mature is characteristic in the male, and most females also have the apical half of elytra pale, which is not the case in any of the specimens of *schaefferi* I have seen.

Ceracis minuta, n. sp.

Very shining, black, with legs and antennae paler. Prothorax wider than elytra, with punctures sparse and finer than those of elytra. Processes of apex strongly developed. Elytral punctures closer and larger than those of prothorax, otherwise the species is like *Ceracis punctulata* Csy., but it is much smaller. 1-01 mm. in length. I took fifteen specimens of this minute species at Palm Beach, Florida, June, 1913. The first ventral segment has a round fovea at middle. This is the smallest *Ciside* I have seen, except the Florida *unicorne* Casey.

Ceracis bifoveatus, n. sp.

A rather slender species, somewhat like punctulata above, in shape, color and size. The elytral punctures being coarser and more dense than those of prothorax, which is squarely truncate at base, alutaceous and at posterior angles strigose. The outer tip of anterior tibiae are rounded and spinulose. The male secondary sexual characters are very peculiar. The epistoma is reflexed and emarginate, and the apex of prothorax is produced into an abrupt process which is deeply notched at tip. The first ventral segment has a large circular fovea, surrounded by a deep groove and is convex in the middle with raised papilliae. Posterior to this and joining it is another fovea, around the posterior half of which is a row of outward radiating yellow bristles. The females lack process and ventral fovea, but are unique in having a deep fovea at middle of front. Length 1-04 mm. Five specimens. Three males and two females. Cincinnati, Ohio.

Ceracis, Mellie

Antennae 8-jointed. Male characters affecting epistoma, prothoracic apex and first ventral segment. In facies they resemble *Ennearthron*. The species may be tabulated as follows:

Rufotestaceous. Elytra blackish towards base. Eastern United States, from Canada to Texas. The most abundant species in Ohio. **sallei** Mellie

Piceo castaneous. Elytra not blackish towards base. Elytral punctuation dual and coarser. Allied to **sallei** Mellie. Brownsville, Tex. **schaefferi** Dury

Castaneous. Prothorax with a smooth, median line posteriorly. Elytra distinctly punctate. Lower California................**similis** Horn

Piceo-castaneous. Elytra strongly rugosely punctate. Secondary sexual marks on both sexes. Cincinnati, Ohio.........**bifoveatus** Dury

Black. Elytra nearly smooth; more finely punctured than prothorax. Florida and Alabama...............................**punctulata** Csy.

Black. Much smaller. Elytra strongly and densely punctured. Punctures of prothorax finer than those of elytra. Palm Beach, Fla. **minuta** Dury

Octotemnus, Mellie

Casey gives a good generic diagnosis in Journal New York Ent. Soc., vol. vi, No. 2, p. 91, and describes two species, *Octotemnus denudatus* and *O. laevis*. The former from the west coast and the latter from the Eastern United States. I have seen the types. In a large series of specimens from many localities the characters given to separate them seem to run together so that I can not find any of specific value to distinguish the two. In both forms the prothorax is alutaceous, with punctures about the same. Some specimens of both are more elongate and less oval. The size averages the same. The darker ones are the more mature ones. The species is a glabrous insect, finely punctured, averaging about 1.75 mm. in length. The males are without sexual marks on either epistoma or prothoracic apex. Color from pale to dark. I have seen specimens from Pennsylvania, Ohio, Alabama, Iowa, Kansas, Oregon, Washington and California. At Cincinnati, Ohio, they live in various species of fungi and are very abundant. Those from Oregon were bred from *Coriolus versicolor* and *Polystictus*.

THE MUSEUM SITUATION IN CINCINNATI*

NEVIN M. FENNEMAN

In many civilized countries of today (and in all civilized countries of tomorrow) the public museum is an essential element. It takes its place with the public library, the stage and the public park. These four are the chief resources of organized entertainment and recreation.

The modern museum is little older than the nineteenth century and there has been more growth in the last fifty years than in all preceding history. The collection of natural objects and curios is as old as civilization, but until recent times such collections ministered to superstition rather than to knowledge. For centuries the bones of extinct animals (mastodon, etc.) were hung on the walls of churches as "giants' bones." This is still the case in certain parts of Europe. Stone axes were similarly exhibited as "thunderbolts" and arrowheads as "serpents' tongues."

One of the oldest natural history museums is the Ashmolean of Oxford. In the first half of the seventeenth century, John Tradescant, Kentish gentleman, traveler and botanist, gardener to Charles I, united with great learning a prodigious greed for collecting. His collections were assembled from the ends of the earth and covered the range of museum classification. His son, John Tradescant, after doubling his father's collections, gave them in 1659 to the famous antiquary, Elias Ashmole. By him they were given in 1682 to Oxford University and became the nucleus of the Ashmolean Museum, well known to scholars and to all who visit Oxford.

The British Museum may be said to have started seventy-one years later (1753) when Parliament purchased the large

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*In writing this paper free use has been made of the proceedings of the American Association of Museums, particularly of articles by E. K. Putnam (Brief Survey of American City Museums, vol. viii), O. C. Farrington (The Rise of Natural History Museums, vol. ix), and Paul M. Rea (various historical and statistical articles).

and varied collections of Hans Sloane, to which others were soon added. The leading place which England has from the first occupied in the matter of public museums is probably due partly to her leadership in exploration, travel and trade. It is certain at least that the first great public collections drew largely upon the New World. It is not strange therefore that the same Englishmen living in that New World should act in the same manner. So the British Museum was only fourteen years old when the Charleston Library Society undertook for the province of South Carolina, the task which the British Museum had assumed for the world. The Charleston Museum was founded three years before the Declaration of Independence, and after a continuous career of one hundred and forty-four years is a model of what may be called the *sectional* museum as opposed to the cosmopolitan museum which represents the world.

The next oldest museum in America is probably the Peabody Museum in Salem, Massachusetts. It was started in 1799 by the Salem East India Marine Society, an organization composed wholly of the masters and supercargoes of Salem vessels navigating the southern seas in the vicinity of Cape Horn or the Cape of Good Hope. Up to 1909, four hundred and six members had passed this test. The collections of this social, charitable and semiscientific or technical society were to consist of "natural and artificial curiosities" brought home from long voyages. Union with other societies of more local interest has made of this museum another good type of the sectional museum. (Robinson, John—Proc. Amer. Assoc. of Mus., vol. v, p. 75.) It is now a part of the well endowed Peabody Institute.

The nineteenth century was so fruitful of museums that only the broad outlines of the movement can be noted. It will be observed that the first museums were founded by societies. Of the six hundred museums and galleries in the United States, more than one-third were thus founded and are now so supported. A slightly larger number are connected with schools or colleges. One-fifth of all are supported by

city, state or national government. The remaining seven percent are in private hands or supported by endowment.

The century following 1773 was preeminently the epoch of the *Natural History Society.* It may be said to have opened with the founding of the Charleston Museum in 1773 and closed with the founding of the Cincinnati Society of Natural History in 1870. It should, however, be remembered that this society had an earlier career under the name of the "Western Academy of Sciences." Many of these societies are in a dying condition. Their rise and decadence contains an element of pathos. Briefly stated, the several sciences, having passed the stage of superstition, had entered the *Natural History stage* and had not yet reached the *laboratory stage.* Zoology and Botany were busy describing and classifying animals and plants and learning their habits. Paleontology was doing similar work with fossils. Every local field was virgin soil and the amateur hunter rendered important service. Most significant of all, the researches of local professors and other scientific men lay along the same lines which enchanted the amateur. Leadership was thus afforded and mutual interest prevailed. There was a democracy in the pursuit of science which passed away when the work of hunting, describing and classifying had been in large measure accomplished and scientific men took up the microscope and the scalpel and gave their thoughts to problems which in their very nature do not lend themselves to popular interest. This may be called the laboratory stage of science. It begets intense specialization and much of it involves quantitative work. The interests of Biology superseded those of Botany and Zoology. Few biologists are now interested in a whole bird, or at least not in the outside of a whole bird.

Inevitable as it is, it would be folly to close one's eyes to the loss which this change involves, or to endure that loss complacently without at least an effort to keep up the ennobling influence of Natural History. Still, the truth must be told, that when the present-day scientific man participates in his local Natural History Society, it is because of a missionary interest and not because of that "enlightened selfishness" which is the

surest guarantee of the life of an organization. Public museums have grown prodigiously since Natural History societies ceased to be founded, but they have not grown for the pleasure of those who finance and manage them, but for the education, entertainment and refinement of the community. They are now benevolent or philanthropic rather than democratic in the old sense. In the old society all were, at least in theory, both givers and receivers of information. Now the distinction between givers and receivers is generally marked.

Such of the old time societies as have survived have either been privately endowed or have been subsidized, generally by their own cities. Of the two already mentioned, the Charleston Museum, beside receiving from the city a $40,000 building, receives $4,000 a year for curatorship and management. The Salem Museum is well endowed. The Philadelphia Academy of Sciences has large collections and ample resources and the Boston Society of Natural History receives nearly $14,000 a year from its endowment. The Davenport (Iowa) Academy of Sciences, founded but three years before the Cincinnati Society and having approximately the same means of support, is one of the very few which has preserved its vigor, but it has done this by entering actively into the educational field. It was one of the first to effect definite cooperation with the public schools.

As already stated, nearly two-fifths of all the museums and galleries listed in the United States belong to educational institutions. For the most part these are "poorly supported, badly cared for and not much seen." In 1909 only five colleges (or universities) and five independent societies appropriated more than $1,000 each to museums. Most colleges depend for curatorship on the voluntary services of science instructors, whose advancement in the world depends on research and not on philanthropic work for the community. Time for museum work must be subtracted from the small time allowed for research and writing. Most college museums are decadent for the same cause which affects Natural History societies. So long as the teaching of science was in the Natural History stage there was great interest in multifarious forms, but this

interest has largely been sacrificed to the intensive work of the laboratory. That the broad Natural History interest has dropped out, even in high schools, is of course an educational crime, but our concern here is with the fact, not with its justification. That such an interest *should* exist and be fostered somewhere, at some age, in some grade of school, or in some kind of an institution, is a proposition too elementary to argue. It need only be said that the Natural History interest where it exists at all, is generally centered, not in the college or university, nor even in the high school, but in the public museum.

But not all university museums are stagnant or decadent. There is, of course, no reason why a successful museum should not be run by a college. The problem is the same as that of the old time Natural History Society. Museums take time and time costs money. An instructor who gets no calls, gets slow promotion, and calls come to the man who investigates and publishes; not to the man who sacrifices his time to his community. Some of the larger universities and colleges, and likewise a few of the smaller ones have successful museums. Some of these have independent endowment. Harvard has the Agassiz Museum (Natural History) with its $600,000 endowment and other sources of income; the Fogg Art Museum similarly supported, the Peabody Museum of Archeology and a number of historical or cultural museums, German, Semitic, etc. Yale also has (among others) its endowed Peabody Museum. Beloit, Bowdoin and Smith have endowed art museums which are much used. Wellesley supports the Farnsworth Art Museum from the funds of the College. The University of Michigan appropriates annually about $7,000, most of it for salaries. The University of Colorado supports a very active museum at about $3,000 a year. Beloit also has its Logan Museum of Archeology. The University of Iowa has just erected a museum building costing (with cases) $450,000, and the University of Indiana has done almost the same. But none of these successful college museums are looked upon as departmental apparatus. None depend for curatorship on voluntary effort and spare time.

The aims of a university museum are two, research and close touch with the public. Elementary teaching does not now demand large collections; but some lines of advanced study are not otherwise possible. State institutions generally find that museums yield large dividends in the form of public interest and presumably therefore in moral and financial support.

We come now to the endowed museum. This is a late nineteenth century development, but the proportions already reached are startling. Twenty-four of our larger museums average well above a million dollars each in endowment alone. The same institutions hold \$50,000,000 worth of property, beside their collections which no man can value. Aside from all administrative expenses these museums paid out in 1910 \$172,000 for research alone, not counting expeditions, explorations and purchase of collections. A vast educational and scientific machine this is, built up almost wholly within twenty-five years.

The class of endowed museums is not very distinct. Some of them, like those of Harvard, receive additional support from educational institutions; others are supported in part by societies or from municipal funds. The Boston Museum of Fine Arts costs more than \$80,000 a year, three-fifths of it yielded by endowment. The Field Museum, with more than five million of endowment, is also the beneficiary of the city of Chicago. Carnegie gave a six million dollar building to the Carnegie Institute of Pittsburg for Natural History, Art, Library and Music Hall. The Natural History Museum has an annual income of \$85,000 and the Art Museum of \$60,000 from endowment. Stephen Salisbury's endowment yields to the Art Museum of Worcester, Massachusetts, an annual income of \$143,000. The Layton Art Gallery of Milwaukee, the Valentine Museum of Richmond, and the Wadsworth Atheneum of Hartford are others of this class.

Overlapping all other methods of support, is the state or municipal subsidy, generally the latter. In state museums, New York no doubt leads, but not many states are in advance

of Ohio. City support comes mainly through two channels, the Park Commission and the public schools, though the public library is in some cases the intermediary. The commonest form of aid is the giving of a site, generally in a public park. Cincinnati did this for her Art Museum. A score of large cities have done the same, but practically all of them, unless it be San Francisco, have contributed also to building or support, or both. New York, besides the millions paid for real estate, spends more than $700,000 a year on the upkeep of her Art and Natural History Museums and zoological and botanical gardens. New York has a well defined policy of paying only for real estate and upkeep. This includes all salaries, but adds nothing to the exhibits. That must be done by patrons of art and science. Her experience is that gifts and money flow in freely when it is known that they go directly into collections. Speaking at the American Museum of Natural History, Joseph A. Choate said: "The money spent by the city of New York in the development of this museum and the Museum of Art is the best investment of public moneys ever made by it, whether we consider the direct benefit to the people, or the prestige and character attained by the city as the great metropolitan center of knowledge and culture." Milwaukee spent one million dollars for a building (museum and library) and gives more than $80,000 a year to museum support. The St. Louis Art Museum, housed in a million dollar exposition building, is authorized by law to receive a mill rate which would yield $120,000 annually, but it is not yet spending more than two-thirds of that amount. The St. Louis School Board also operates an educational museum, costing about $8,000 per year. Among the various museums partially supported by Philadelphia, the one called the Philadelphia Museums receives from the city from $40,000 to $60,000 per year, beside $25,000 from the state for educational work and substantial allotments for new collections. The John Herron Art Institute of Indianapolis, beside receiving $5,000 a year from membership, receives $9,000 from the School Board. Beside St. Louis and Milwaukee already named, Providence,

Oakland, Grand Rapids, Los Angeles and some others have strictly municipal museums. The list of those receiving city aid would be wearisome. Even Chicago gives $65,000 a year to her Art Institute and has provided for giving $100,000 a year to the richly endowed Field Museum when its new building on the lake front is completed.

Before taking a brief outlook over the field in Cincinnati, a distinction should be made among museums with respect to their geographic scope. The great museums of London, New York, Chicago, etc., take the world for their field and disregard no line of interest. These may be called cosmopolitan. At the other extreme are strictly local museums which undertake to represent their own localities adequately. A large gallery of sculpture in Copenhagen contains, beside the tomb of the artist, nothing but the models and casts by Thorwaldsen. Intermediate between these types is the museum which represents a limited region; it may be a political division or a vaguely defined section. This may be called the sectional museum. An example of rigid restriction is the Ohio State Museum at Columbus, which restricts itself to Ohio and aims to approach completeness as rapidly as possible. The Germanic National Museum at Nuremberg represents only Germany. The "Nordiska Museet" at Stockholm is perhaps the most perfect example. It limits itself to Sweden and includes art, history, and botanical and zoological gardens. In Skansen Park it has perhaps the most famous outdoor museum of the world; whole houses and households with their occupants, occupations and amusements from all parts of Sweden and, so far as possible, from all stages of her history. The Deseret Museum of Salt Lake, supported by the Mormon Church, the Southwest Museum of Los Angeles and the Museum of the American Institute of Archeology at Santa Fe are excellent examples of the sectional museum.

For evident reasons art museums are rarely thus restricted. Natural History Museums frequently are; Historical Museums oftener still. Cincinnati could not wisely undertake a cosmopolitan museum. Her appropriate field is the Ohio Valley.

She ought not to be satisfied to see any other city becoming the representative metropolis of this section.

The field of the museum is fourfold—Art, History, Science and Industry. Not many American cities are ahead of Cincinnati in Art, but a few are a long way ahead and some others are gaining faster. In 1912 our Art Museum had an income of $34,000 exclusive of the Academy, whose receipts were nearly $24,000. Beside Painting and Sculpture, this museum represents Indian Archeology, though it is not in position to push this line aggressively. With this line and its armour and musical instruments, this museum occupies a part of the Historical field.

Cincinnati's traditions and tastes in Art and Music are priceless, but unsleeping vigilance is the price of their continuance. Cultured people die and children are not born with tastes for the Fine Arts. If Cincinnati aims to beat her rivals she can do it better in the game of Music and Art than in the population game. But as a man is generally vain with respect to his weakest point, so a city seems sometimes possessed to wage war where its own lines are weakest and the enemy is strongest. The thing for the Cincinnati traveling man to do is to post up on Music and Art and then tell the other fellow when he has talked enough about the census.

In most American historical museums the most important thing is Indian Archeology. Our collections in this line, while valuable, do not even approximately represent the knowledge gained from even our own immediate locality. It would not have been extravagant to hope that Cincinnati might in this respect have represented the Ohio Valley. Living as we do at a kind of focus of prehistoric civilization which left abundant remains, it is not creditable to this community that the student of Ohio Valley Archeology must go to Columbus to make a fair beginning, and then to Washington, Boston, and perhaps to England to examine the data of his science. For seventy-five years Ohio has been a hunting ground for relics of the stone age. About 1846 Squier and Davis made one of the largest of such collections. It was stored for some time in the

State House at Columbus, then at the Smithsonian, and then sold to a gentleman in England where we must now go to complete our studies of Ohio Archeology. After much of the material had been removed, Ohio started its state museum to which it now gives $7,000 a year and an excellent building for the purpose of assembling Ohio material only. As for material remaining in Cincinnati, the best known collection is now in our Art Museum. Smaller collections are found at the Natural History Society and at the University, and there is an unknown amount of good material in private hands. Its value can not be known until it is studied, but the amount still available would do something worth while toward retrieving our loss.

Aside from what is contained in the Art Museum, Cincinnati can scarcely be said to have an historical museum. There is room here for a prosperous society and an interesting museum. What advantage over Cincinnati has St. Louis, which enabled it to assemble one of the richest historical collections in the United States? If one were asked to guess at what point west of the original thirteen states such a museum should be found, he would look to a locality which had been of critical importance in aboriginal culture, settled early by the white man, the center of a large population and a point intimately associated with the great movements of war and peace. Such a place is Cincinnati, but the objects which illustrate or symbolize the great events or daily life of former times are not conserved for instruction and inspiration.

A coin collection which any museum in the world might covet was made in Cincinnati by the late Thomas Cleneay. On his death it left the city to be sold at auction in Philadelphia. Even in this manner the collection brought nearly $20,000, partly from the United States Government.

Coming to the realm of Natural History, Cincinnati appears in her best light and her worst. In the content of her Zoological Garden she is definitely outranked by New York alone, being roughly coordinate with Philadelphia and Washington, though the race with Washington is hopeless. Chicago

is beginning to crowd us. All these are subsidized by their respective cities, except our own. Even the one at Philadelphia receives municipal support of $25,000 a year. There are fifty-four zoos in the United States, that is, about one-half the cities of over 40,000 are supplied. Most of them are under the auspices of Park Commissions. New York and Detroit have extensive aquariums similarly supported.

The Botanic Garden is similar to the zoo in its social function. In all parks, of course, shrubs and trees are planted, and greenhouses are common, but a botanic garden to be worthy of the name ought to be comparable to a zoological garden in its harboring of exotic species. The richly endowed Shaw Gardens at St. Louis are perhaps the most important west of New York. The great advantages of Cincinnati in this respect are similar to those of St. Louis. It lies in the critical latitude where northern and southern species meet and acclimatization is correspondingly favored. Its topography offers a wide range of conditions, and above all, its people love flowers. A private garden planted and lovingly cared for by Mr. Tuchfarber, of Westwood, is now the property of Mrs. Mary Emery and kept for the public good. This may be the germ of something greater, but if Cincinnati is ever to have a really great botanic garden, it is more likely to develop in the Mt. Airy Forest, now city park property. The topography there is highly varied. On account of its location with respect to our prevailing winds, it is freer from smoke than any other part of the city (a very important matter in a botanic garden).

The Professor of Botany at the University once had a very modest plan of assembling in one spot, duly provided with greenhouses, all the shrubs and flowers which might be desirable for landscape gardening, public or private, in the city; such a collection to constitute a kind of reference library or showcase which anyone might consult for the purpose of choosing shrubs, flowers, and to some extent even trees to beautify his home or street, or to be of similar service to park managers. It would seem that such a project would lie well within the province of the Park Commission.

Natural History Museums owe most of their materials to two sciences: Zoology and Geology. In resources of these classes, no city in the United States is so favored as Cincinnati. Those which approach it in geologic interest do not have the zoos to supply skins and skeletons; and those which have the zoos do not have the fossils. Our zoo contained in 1909, five hundred and twenty mammals, twelve hundred birds and one hundred and twenty-five reptiles. There die each year, say, forty-five to fifty mammals, one hundred to one hundred and twenty-five birds and twenty-five to thirty reptiles. (Letter from Sol. A. Stephan, Manager.) The skins of these should be preserved. Many of them are valuable. Not all should be mounted. Many should be used as exchanges. In this way a valuable collection of skins and mounted specimens should accumulate. In scientific research these are used at least as much as the live animals. It is folly to think that they do not attract the people. This has not been New York's experience.

Fossils are, of course, our chief stock in trade. For fossils in the hills we lead all American cities; but when the ground has been patiently searched and the specimens lovingly cared for, the valuable collections have with few exceptions been drawn away to other cities. Harvard, Washington and Chicago, at least, have better collections than remain with us. Eminent research students generally visit those cities instead of Cincinnati in order to study our Paleontology. Still, a large amount of material remains. Its value is hard to state, for it can not now be duplicated. From rock long exposed, fossils are easily separated if not actually found loose. Such exposures have been in large part picked over. The new exposures constantly being made, yield their treasures with difficulty. The collections at the Natural History Society, of which fossils constitute perhaps one-half, have been valued at about $50,000, but at dealers' prices the value would be considerably greater. The collections of fossils alone owned or held by the University could certainly not be bought from dealers at less than $20,000. This would be greatly increased by shells and minerals. Several valuable collections still remain

in private hands. If all duplicates in excess of six for any one species could be exchanged for material of other localities, the value would again be greatly increased. Thus a fair chance still remains for Cincinnati to piece together a representative collection of what her own rocks yield. How long this chance will last is uncertain, for the largest single collection is in the market. The collection here referred to is that of the late Samuel A. Miller, temporarily loaned to the University. To let this slip would be to dishonor the names of the distinguished geologists who were born here or spent their lives in Cincinnati.

But the question of museums should not be thought of in terms of any one science, or any one generation, or any one city. The preservation of records is a mark and measure of civilization whether the records be in language or in concrete objects. The widespread awakening of the last twenty-five years is not so much a sudden burst of civilization as a symbol and phase of conservation and a method of education. Park Commissions and School Boards seem to share about equally the responsibility for this intellectual entertainment of the people. In favored cities private munificence has done more than either, but its work has been more localized. Undeniably, the work has entered a new and more vigorous phase, since it has ceased to be the semisocial entertainment of the few and has taken its place in community education.

The late William Hubbel Fisher, who was President of our Natural History Society at the time of his death, was one of those who saw clearly the changed conditions and the new opportunities. Under his guidance the Society prepared cases of specimens (birds, minerals and insects) to be circulated among the schools. With no improvement since they were first made, and no increase in number (seven sets of three cases each), these continued to circulate up to the year 1916. The greedy demand for these poor makeshifts is pathetic. When they had been circulating five years, Mr. Norman W. Harris, a Chicago banker, visited Cincinnati (among other places) to ascertain the workings of the plan. Several months later he announced a gift of $250,000 to the Field Museum, to endow a

system of museum extension for the public schools of Chicago. Not only were traveling collections provided, but the necessary auto truck service to keep them in circulation.

The large sums of money spent for museums in some of our cities may be discouraging. It should be remembered that these are for cosmopolitan institutions. In such institutions exploration and research are important and expensive. In the local or sectional museum a few thousand dollars goes a long way. Aside from the upkeep of a suitable building and the cost of cases, the salary of a single taxidermist would give Cincinnati a renowned collection of birds and animals in twenty-five years. Almost the same is true of fossils, if the beginning were made before any more breaks occur. Archeology would make a good showing on the same terms. Some lines would depend on purchase, but in the course of twenty-five years, the really valuable donations from a half million people would be very large.

NOTES ON RICHMOND AND RELATED FOSSILS

AUG. F. FOERSTE

The following notes are based upon a number of specimens collected by John Misener from the upper half of the Richmond group, at Richmond, Indiana. To this is added a discussion of *Dinorthis retrorsa*, Salter, a very rare species from the Bala group of Wales, with which it is customary to identify *Dinorthis carleyi*, Hall, from the Richmond of Ohio, Indiana, Kentucky and Tennessee. Figures are presented also of the type of *Zitteloceras hallianum*, D'Orbigny, from the Trenton of New York, with which *Cyrtoceras hitzi*, Foerste, from the Hitz layer, at the top of the Richmond group at Madison, Indiana, evidently is congeneric.

Conularia miseneri, sp. nov.

Plate I, Figs. 1 A, B, C

Shell elongate-conical, rhomboidal in cross section, rarely exceeding 40 millimeters in length. Apical angle from 15 to 18 degrees. Lateral angles strongly rounded. Lateral faces gently concave along the median line. Transversely and longitudinally striated. The transverse striations always are well defined; from 22 to 25 in a length of 5 millimeters; curvature gently convex across the median parts of the lateral faces, curving gently downward (toward the apical end) at the lateral angles. This downward curvature is greater toward those angles which are at the extremities of the longer transverse diameter, and the maximum convex curvature of these transverse striae lies nearer those angles which are at the extremities of the shorter transverse diameter of the shell. The longitudinal striae frequently are indistinctly defined along certain parts of the shell, especially near the upper end where the transverse striae often are much closer, suggesting gerontic conditions. In most specimens, however, parts of the shell show the longitudinal striae, but much less distinctly than the transverse ones. The number of longitudinal striae

in a given width varies greatly, from moderately fewer than the transverse striae in the same length to considerably more numerous.

Whitewater member of the Richmond group, at Richmond, Indiana; found by John Misener. Occurring also at the same horizon at the eastern edge of Dayton, Ohio, at the northern end of Huffman hill, where the Springfield traction line crosses over the railroad to Wellston.

Amphilichas sp.

Plate I, Fig. 2

Specimen exposing the lower side of a pygidium and of several of the posterior segments of the thorax. Margin of pygidium with three pairs of lobes. The terminations of the posterior pair are more or less rounded, and are separated by a short narrow notch. The lateral pair of lobes is more angular, and is separated from the posterior pair by a slightly deeper and wider notch. The anterior pair is not preserved in the specimen at hand, but probably resembled the middle pair. A sharply defined rib extends, on the lower side of the pygidium, from the lateral margin of the axial lobe of the pygidium approximately along the line separating the posterior and middle pairs of lobes, and another extends between the middle and anterior pairs. Beginning nearer the posterior margin of the axial terminations of these lobes, an additional rib extends diagonally forward toward the ends of the posterior and middle pairs of lobes. A corresponding median rib curves so as to approach the lateral posterior termination of the axial lobe. The axial lobe of the pygidium is prominent anteriorly, and becomes lower and narrower to a point about six-tenths of the length of the pygidium from the anterior margin, after which the sides of the axial lobe diverge again. All of the ribs beneath the pleural lobes of the pygidium probably locate more or less distinct grooves on the upper, not exposed side of the pygidium. Two segments are indicated at the anterior end of the axial lobe. The anterior one of these is short but

distinct. The second is much shorter, and comparatively indistinct; its posterior margin is on a line with the inner termination of the median rib of the middle pair of lobes. The reflexed margin or doublure extends back for almost half the length of the pygidium along its middle part. The entire exterior surface of the pygidium is covered by small granules, about a sixth of a millimeter in diameter.

Found in the Whitewater division of the Richmond group, at Richmond, Indiana, by John Misener. The species evidently is closely related to *Amphilichas halli*, Foerste, from the Corryville member of the Maysville group, at Cincinnati, Ohio.

The Misener collection contains also a fragment of a pygidium of *Arctinurus harrisi*, Miller, obtained from the immediate vicinity of Richmond, Indiana. In Bassler's Bibliographic Index of American Ordovician and Silurian Fossils, the type is listed as coming from the Liberty member of the Richmond, near Waynesville, Ohio. Figure 1 on plate III is a diagrammatic representation of the pygidium of this species. It is characterized chiefly by the acute termination of the axial lobe. The three pairs of lateral lobes are rounded and subequal.

Tripteroceras (*Lambeoceras*) *richmondensis*, sp. nov.

Plate I, Figs. 3 A, B, C, D; Plate III, Fig. 2

Orthoceracone greatly compressed, transverse section (figure 2, on plate III) lenticular, the lateral edges acute. Radius of curvature across the middle of the septa slightly more than half of the chord connecting the ends of the arc formed by the septa; for instance, the radius of curvature of the lowest septum preserved in the specimen figured is 28 millimeters, and the lateral diameter of the shell at this point is 53 millimeters. Along the ventral side of the shell the transverse curvature of the septa is somewhat greater than on the dorsal side, causing the suture line on this side to rise more rapidly than on the dorsal side until within a distance of 5 to 7 millimeters of the acute lateral angles of the shell,

beyond which there is a slight reversal of curvature. This causes the lateral parts of the septa to slope moderately upward from the dorsal toward the ventral side.

The dorsal and ventral sides of the orthoceracone are about equally convex. The radius of curvature equals about seven-tenths of the chord connecting the ends of the arc formed by the curvature. The lateral sides diverge at an angle of about 7 degrees. The antero-posterior diameter of the shell is 20 millimeters where its width is 53 millimeters. From this point upward 10 chambers occur in a length of 48 millimeters.

The siphuncle, or at least the cast of its interior, is nummuloidal, the lateral diameter being 7 millimeters where the shell is 53 millimeters wide. The more exact structure of the siphuncle has not been determined.

This species occurs in the Whitewater division of the Richmond, at Richmond, Indiana, where the specimens here figured were collected by John Misener. Similar specimens occur in the Emswiler collection in the Museum of Earlham College, at Richmond, Indiana, and are there numbered 8205 A, 8205 B, and 8206 A.

In Bassler's Bibliographic Index of American Ordovician and Silurian Fossils (Bull. 92, U. S. Nat. Mus., 1915), seven species are listed under *Tripteroceras.* In six of these species, including the genotype, *Tripteroceras hastatum,* Billings, the ventral side is strongly flattened and the dorsal side is more or less triangularly convex. However, in *Tripteroceras lambi,* Whiteaves, these two sides are almost equally convex, the transverse section is fusiform, the lateral angles are almost acute, the siphuncle is nummuloidal, and the margins of the septa are deeply concave on both the ventral and dorsal sides. For this species the subgeneric term *Lambeoceras* is here proposed.

Tripteroceras richmondensis is closely related to *Tripteroceras lambi.* The differences are slight. In *Tripteroceras richmondensis* the angle of divergence of the lateral outlines is less, and the septa are more strongly concave and form a more acute angle with the lateral margins.

Tripteroceras lambi was described as from the Trenton or Black River strata at East Selkirk, in Manitoba, but in Bassler's Bibliographic Index the possibility of the East Selkirk horizon belonging to the Richmond is indicated. Clarke identified with this species a closely similar form from the middle Galena at Stewartsville, Minnesota, but here also Bassler questions the reference of the horizon to the Trenton.

Conchopeltis miseneri, sp. nov.

Plate I, Figs. 4 A, B

Shell patelliform, with an upturned beak, the curvature of the shell immediately posterior to the beak being concave, the concave tendency remaining as far as the posterior margin of the shell, but to a lesser degree. Possibly there is also a slightly concave curvature from the beak forward, toward the anterior margin, but this can not be determined definitely from the specimen at hand. From the beak two grooves extend forward, one on each side of the shell, forming angles of about 150 degrees with each other. Anterior to these grooves (marked A, A, in figure 4 on plate I), the shell is comparatively smooth or is marked only by obscure and narrow radiating plications. Posterior to these grooves the shell is strongly and radiately plicated. Of these plications there are eleven. The anterior pair, one plication on each side of the shell, is almost as broad as the third pair, but the crest lies nearer the posterior margin. The second pair (marked B, B, in the figure) is conspicuously narrower. The remaining plications, seven in number, are strongly convex, and are separated by comparatively deep concave grooves. The entire shell is marked by concentric lines of growth. These lines indicate that the general outline of the shell was oval or nearly circular, and not quadrilobate as in *Conchopeltis alternata*, Walcott, from the Trenton limestone of New York, the type species of the genus. In the species here described there may have been a slight indentation of the margin of the shell at the ends of the anterior grooves (marked A, A, in the figure), giving the

appearance of an anterior lobe, but this part of the margin of the shell is not preserved in the specimen at hand.

This specimen is imperfect, and exhibits only the interior of the shell. The figure here presented consists of a cast of this interior. No muscular or vascular markings are discernible. The species occurs in the Whitewater member of the Richmond group, and the type was found by John Misener, at Richmond, Indiana.

Dinorthis retrorsa, Salter

Plate II, Figs. 1 A, B, C; Plate III, Figs. 4, 4a, 4c

Orthis retrorsa, Salter, was described (in the Memoirs of the Geological Survey of Great Britain, vol. 2, pt. 1, 1848, p. 373, pl. XXVII, figs. 3, 4) by Salter as a variety of his *Orthis inflata*. His original description follows:

> Ventral valve gibbous, the center rather raised. Dorsal flat, broadly depressed along the middle, edge not recurved; beak suppressed; area at an obtuse angle with the valve.
>
> *Locality.*—Bird's-hill Quarries, North of Llandilo, in limestone.

In this description the terms ventral and dorsal are used in the same sense as that in which they were employed by Hall in volume I of the Paleontology of New York, published in 1847, and familiar to American readers. Later these terms were employed by paleontologists in a directly opposite sense, and more recently the terms pedicel and brachial have come into use, so that a revised version of the original description of *Orthis retrorsa* would read:

> Brachial valve gibbous, the center rather raised. Pedicel valve flat, broadly depressed along the middle, edge not recurved; beak suppressed; area at an obtuse angle with the valve.

Two sets of figures, differing distinctly in outline, accompany the original description, and are reproduced with the original numbering on plate III of this journal. Figure 3 evidently represents the brachial valve of a species of *Hebertella* while figure 4 represents the pedicel valve of a species belonging to the *Plaesiomys* division of *Dinorthis*. The term *retrorsa* refers to the retrorsion of the beak of the pedicel valve, and hence the specimen represented by figure 4 is regarded as the type.

This figure appears to be based upon specimen 11212 in the Museum of Practical Geology, in London, and two additional figures of this specimen, one from a plaster cast (Fig. 1A), the other from a dental wax squeeze (Fig. 1B) are presented on plate II. A second specimen, collected at the type locality about 11 years ago, consists of two small slabs, one the obverse of the other, bearing the numbers J. P. 4031 and 4032, in the Museum of the Geological Survey of Great Britain, Fig. 1C on plate II is based on a plaster cast of a part of the slab numbered 4032. The type locality is described as: the Old Quarry (the first quarry south of the Quarry Cottage) 200 yards northwest of Birdshill farm, Llandeilo, 6″ 33 S. W. E., 1″ 212 Carmarthen, in southern Wales. Horizon: Bala.

It is evident that Salter's description of *Orthis retrorsa* was intended to contrast with that of his *Orthis inflata*, printed on page 372 of the same publication, in which the brachial valve is described as "strongly gibbous, a little emarginate in front," while the pedicel valve is described as "convex at the beak, then flat, or broadly depressed along the middle, the sides recurved; its area broadish, at right angles to the valve."

Orthis inflata was described from the Coniston limestone, in Westmoreland, in northern England; and was stated to occur also in North Wales. One of the specimens in the collections of the Geological Survey of Great Britain numbered 26039, and listed as "*Orthis*, Coniston limestone, Coniston," represents a pedicel valve of this species. The small fragment of the hinge area remaining on each side of the foramen is distinctly at right angles to the valve, and the quadrangular muscular impression follows the description presented by Salter. This specimen is illustrated by figure 1D, on plate II. Evidently *Orthis inflata* belongs to the *Dinorthis subquadrata* group of species, while *Orthis retrorsa* is a retrorse form, closely similar to, if not identical with, *Dinorthis carleyi* among American species.

The Coniston limestone is a member of the Bala group; therefore both *Orthis inflata* and *Orthis retrorsa* belong to the same general group of strata, but one species may have pre-

ceded the other within this group. The Bala group of Wales and England corresponds approximately to the Mohawkian division among American strata, and in these Mohawkian strata of America species occur which unquestionably belong to the retrorse division of *Dinorthis*. Among these is the species collected by Billings (Palaeozoic Fossils, vol. I, 1865, p. 136, figs. 112 a, b) from the Trenton at Ottawa, Belleville, and near l'Original, in Canada, and also the species figured by Ruedemann (New York State Museum Bulletin, 162, 1912, p. 93, pl. 4, figs. 9–12) from the Snake Hill (Trenton) beds, in Saratoga county, New York. Compared with the type of *Orthis retrorsa*, these Trenton specimens are much smaller and apparently have a more nearly circular outline.

Dinorthis carleyi, Hall (Figs. 3 A–E, on plate II of this journal), from the lower or Arnheim member of the Richmond group, in Ohio, Indiana, Kentucky, and Tennessee, also usually is more elongate and more circular in outline than the type of *Orthis retrorsa*, but not enough specimens of the latter are known to indicate its range of variation in form. The assumption that *Dinorthis carleyi* eventually will prove distinct from typical *Dinorthis retrorsa* is based upon the fact that they come from very different horizons. Until the brachial valve of *Dinorthis retrorsa*, from the type locality in Wales, is known, it will be impossible to discriminate the American Richmond forms with any degree of certainty.

Dinorthis carleyi insolens, Foerste (Figs. 2 A, B, on plate II), from the base of the upper or Blanchester division of the Waynesville member of the Richmond group, in Ohio and Indiana, is merely a variety tending to have broader and flatter plications.

The brachial valve (Figs. 3, 3a, 3b, on plate III) erroneously described and figured by Salter as belonging to *Orthis retrorsa* evidently is a *Hebertella*, as already stated. It is numbered 11213 in the Museum of Practical Geology, in London, and figure 1F on plate II of this journal represents a view of a plaster cast of the same specimen, with an attempt to indicate the probable original outline of the valve. Figures 1G and 1H,

on the same plate, represent similar attempts to indicate the outlines of the brachial valves of this species. They were prepared from plaster casts, taken from specimens numbered J. P. 4067 and 4024 respectively in the register of the Geological Survey of Great Britain. These specimens were obtained about 11 years ago at the same locality as that of the specimen figured by Salter, namely Bird's-hill. All three specimens show distinctly the strong convexity and the low, but comparatively broad median elevation demanded by Salter's description and figures. Whether specimen J. P. 4078, represented by figure 1E on plate II, belongs to the same species of *Hebertella* is uncertain. Figures 1F and 1G probably give the more usual outlines of the species. Figure 1H represents an unusually nasute specimen; the postero-lateral angles undoubtedly are too angular. Figures 3e to 3h on plate III indicate the amount of curvature, along the median line, of the brachial valves bearing the same letters in figure 1 on plate II, and figures 3E to 3H on plate III indicate the corresponding lateral curvature across the center of the valves.

These specimens of *Hebertella* from the Bird's-hill locality apparently represent an unnamed species for which the term *Hebertella Llandiloensis* here is proposed. From *Orthis porcata*, M'Coy, if differs in its larger size and in the tendency toward a distinct median elevation. Moreover, the beak of *Orthis porcata* is not retrorse as in *Orthis retrorsa*, the former species belonging to the *Dinorthis subquadrata* group. *Orthis grandis*, Sowerby (Murchison's Silurian System, 1839, p. 638, pl. 20, figs. 12, 13), and *Orthis grandis*, Portlock (Report on the geology of the County of Londonderry and of parts of Tyrone and Fermanagh, Dublin, 1843, p. 452, pl. XXXII, fig. 25), are two much more finely striated species, with a much more quadrangular outline posteriorly, apparently belonging to the *Strophomenacea* rather than to the *Orthacea*.

All of the British specimens here figured were identified by Dr. C. A. Matley, and were loaned by Dr. F. L. Kitchen, the Paleontologist of the Geological Survey of Great Britain, to Dr. F. A. Bather of the British Museum, for the preparation

of the plaster casts. To all of these eminent paleontologists I am greatly indebted for these courtesies. Specimens of *Orthis retrorsa*, from anything near the type locality, are exceedingly difficult to obtain, and the specimens here illustrated represent practically all of the known material available.

Zitteloceras hallianum, D'Orbigny

Plate III, Figs. 5 A, B

1847. Cyrtoceras lamellosum, Hall (not Verneuil, 1842), Pal. New York, 1, p. 93, pl. 41, figs. 2 a–c.

1849. Cyrtoceras hallianus, D'Orbigny, Prodr. Pal., 1, p. 1.

The type of *Cyrtoceras lamellosum*, Hall, numbered 823, is preserved in the American Museum of Natural History, in New York City. It is a fragment 23 mm. long, and of this length about 10 mm. belongs to the body cavity. This is followed by five chambers occupying a length of about 5.5 mm. The width is slightly greater than the length, the width at the base of the body cavity being 11.5 mm., and the antero-posterior diameter 9.5 mm. The rate of tapering toward the apical end is small, the lateral diameter at the smaller end of the fragment being 9 mm. The surface is ornamented by rather distant sharp, undulate, transverse, squamose lamellae. Of these there are eight in a length of 10 mm. Along the median part of the ventral side these well defined transverse lamellae are curved strongly toward the apical end for a distance equal to about the distance between the lamellae. Originally these lamellae may have extended for a distance of about half a millimeter from the general surface of the cyrtoceracone; they evidently represent stages of growth. Laterally, these lamellae undulate in a series of scallops, as indicated on the upper left-hand part of the accompanying illustration, figure 1A.

The type was obtained in the Trenton limestone at Middleville, New York.

It is evident that *Cyrtoceras hitzi*, Foerste (Denison Univ. Bull. XVI, 1910, p. 78, pl. I, figs. 7 A, B; pl. II, figs. 23 A, B, C), from the uppermost Richmond strata exposed at Mad-

ison, Indiana, is a closely related species, and therefore should be referred to *Zitteloceras.*

Zitteloceras clarkeanum, sp. nov.

1897. Cyrtoceras hallianus, Clarke, Geol. Minnesota, 3, pt. 2, p. 805, pl. 60, figs. 11, 12.

The specimen figured by Clarke from the Platteville member of the Black River group, at Janesville, Wisconsin, differs from the type of *Zitteloceras hallianum* in its ovate cross-section, more rapid attenuation toward the apical end, and larger size. The regularly spaced squamose growth-lamellae of *Zitteloceras hallianum* are replaced by numerous lunate markings with the convex side turned toward the larger end of the specimen, apparently similar to the ornamentation presented by *Cyrtoceras* (*Glyptodendron*) *eatonense*, Claypole, as figured in the Geology of Ohio, volume VII, on page 536, in 1893.

The specimen figured by Clarke is regarded as sufficiently distinct to receive a separate designation, and hence the name *Zitteloceras clarkeanus* is proposed, in honor of the distinguished paleontologist, John M. Clarke, who first described it.

PLATE I

Fig. 1. Conularia miseneri. A, natural size of cast of specimen; B, outline of cross-section of same; C, same specimen, enlarged 5 diameters, and illuminated so as to show the vertical striations. Whitewater member of Richmond group, at Richmond, Indiana.

Fig. 2. Amphilichas sp. Lower side of pygidium and of parts of several segments; the two anterior lobes and the middle lobe on the right side of the pygidium are missing. Whitewater member of Richmond group, at Richmond, Indiana.

Fig. 3. Tripteroceras richmondensis. A, ventral side; B, lateral view of inverted specimen, showing location of siphuncle, toward the lateral angle the septum slopes from the dorsal toward the ventral side in a direction away from the apical end of the specimen; C, weathered specimen, with indications of the nummuloidal fillings of the interior of the siphuncle. D, a similar weathered specimen apparently showing the exterior of the siphuncle. The exact structure of the siphuncle has not been determined. Whitewater member of the Richmond group, at Richmond, Indiana.

Fig. 4. Conchopeltis miseneri. A, cast of specimen with approximate outline indicated, exact outline unknown. A, A, anterior pair of grooves limiting anterior "lobe" in which strong radiating ribs are absent. B, B, C, C, second and third pair of ribs or plications. F, posterior, unpaired plication. B, outline, on lateral view. Whitewater member of Richmond group, at Richmond, Indiana.

All of the specimens on this plate were collected by John Misener.

PLATE II

Fig. 1, A, B, C. Dinorthis retrorsa, Salter. Pedicel valves; A, B, two views of the type, from Bird's-hill, north of Llandilo, in southern Wales. C, another valve from the same locality.

Fig. 1, D. Dinorthis inflata, Salter. Interior of pedicel valve from the type locality: in the Coniston limestone, at Coniston, in northern England.

Fig. 1, F, G, H. Hebertella Llandiloensis, sp. nov. Brachial valves. F, figured incorrectly by Salter as one of the valves of Dinorthis retrorsa; G, H, other valves from the same locality: Bird's-hill, north of Llandilo, in southern Wales. E, another brachial valve from

the same locality, possibly belonging to the same species. All of the figures on this plate which are numbered under 1 are from plaster casts prepared by Dr. F. A. Bather of the British Museum, from the original specimens.

Fig. 2. Dinorthis carleyi insolens, Foerste. A, B, pedicel valves. From base of Blanchester division of Waynesville member of Richmond group, near Miltonville, Ohio.

Fig. 3. Dinorthis carleyi, Hall. A, B, pedicel valves; C, brachial valve; D, E, interiors of pedicel valves. Arnheim member of Richmond group, at Oregonia, Ohio.

PLATE III

Fig. 1. Arctinurus harrisi, Miller. Pygidium of type, Liberty member of Richmond group, Waynesville, Ohio.

Fig. 2. Tripteroceras richmondensis, sp. nov. Transverse section of specimen represented by figure 3 on Plate I.

Fig. 3. Hebertella Llandiloensis, sp. nov. 3, brachial valve erroneously figured by Salter as belonging to Dinorthis retrorsa; a, posterior view of the same; b, posterior view of same combined with that of Dinorthis retrorsa; e–h, outlines indicating curvature from beak to anterior margin of specimens bearing the same letter in figure 1 on plate II; E–H, corresponding transverse sections across the center of these valves. Bird's-hill, north of Llandilo, in southern Wales.

Fig. 4. Dinorthis retrorsa, Salter. Pedicel valves; 4, 4a, exterior and cast of interior. The original of the latter appears to have been lost. c, outline indicating slope of hinge area and curvature of valve along the middle line, from the beak to the anterior margin.

Bird's-hill, north of Llandilo, in southern Wales. Figures, 3 3a, 3b, 4, 4a are reproductions of the original figures accompanying the description of Orthis retrorsa, by Salter, in the Memoirs of the Geological Survey of Great Britain, vol. 2, pt. 1, on plate XXVII, and retain the original numbering.

Fig. 5. Zitteloceras hallianum, D'Orbigny. A, lateral view; B, ventral view, enlarged 2.6 diameters. Type, numbered 823, in the American Museum of Natural History, in New York City. From the Trenton limestone, at Middleville, New York.

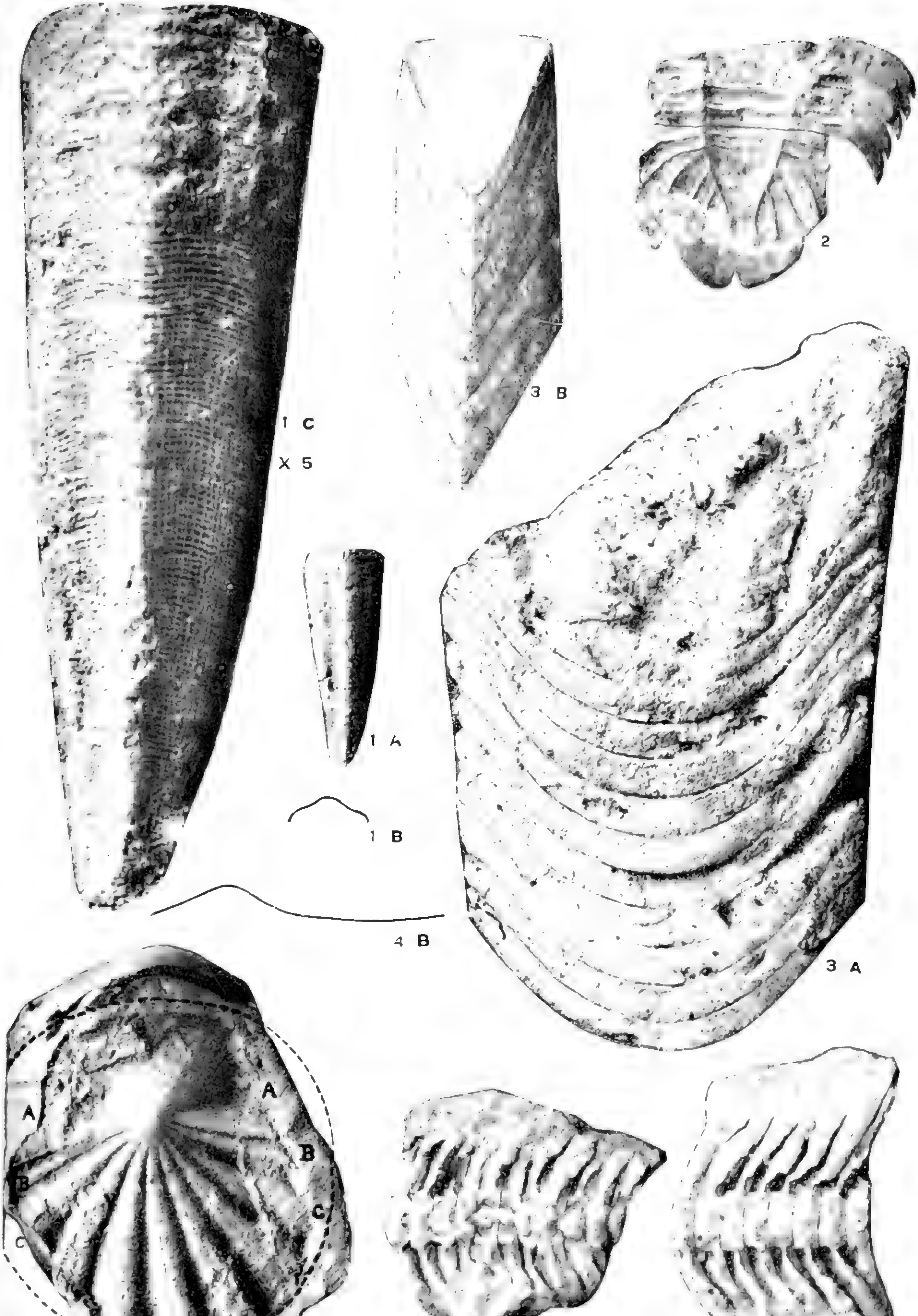

Plate I

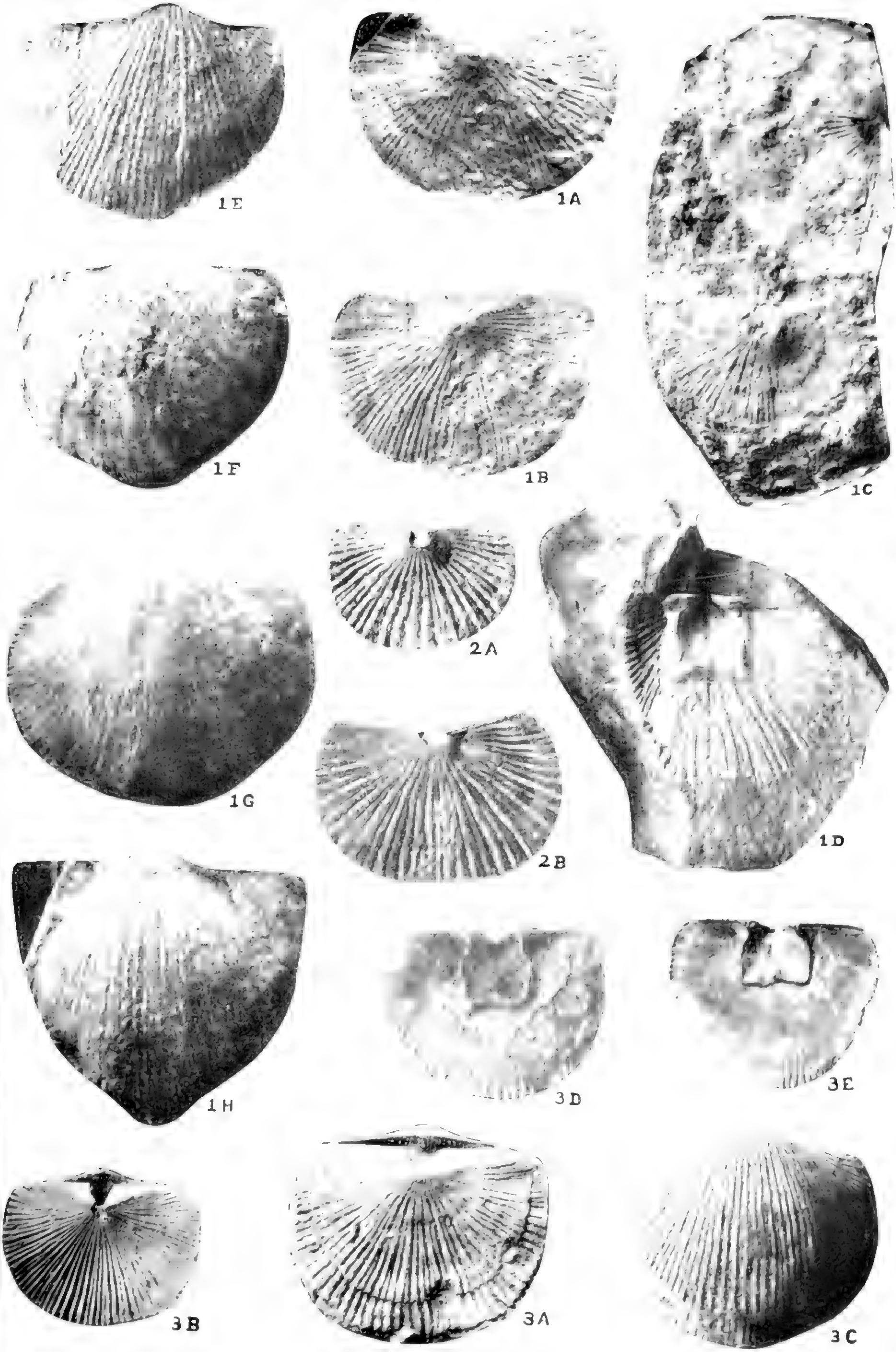

Plate II

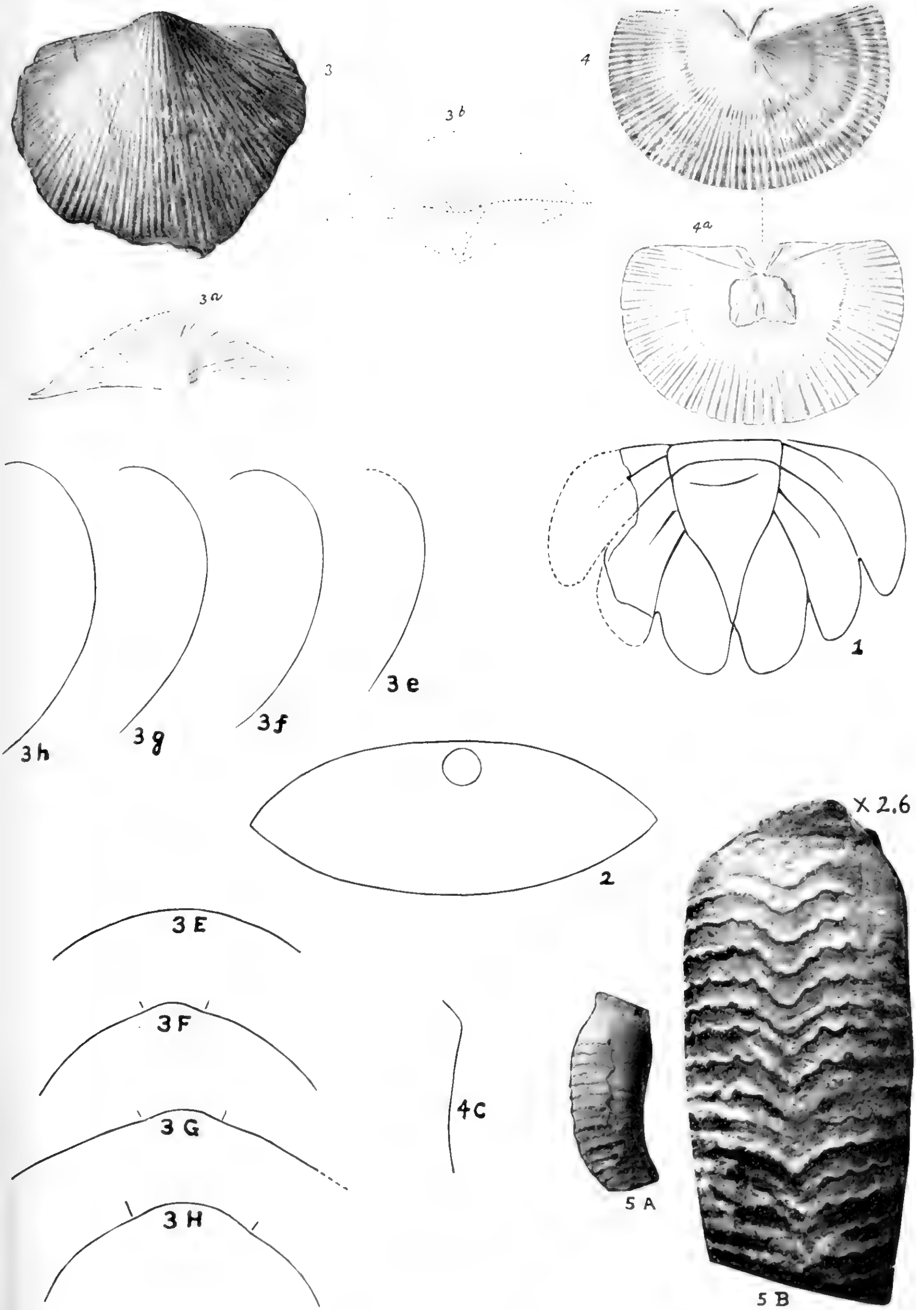

Plate III

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